CIVIL ENGINEERING

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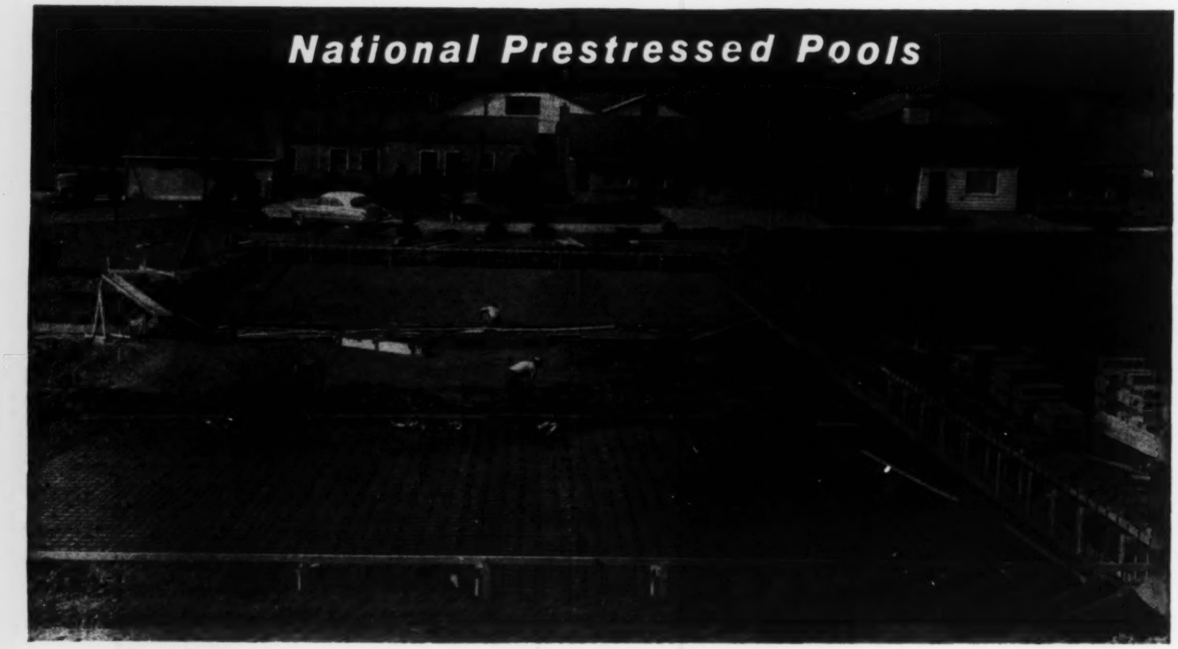
AMERICAN SOCIETY OF CIVIL ENGINEERS
FOUNDED 1852

32-UNIT HYDRO PLANT AT BARNHART ISLAND WILL GO ON LINE IN 1960. SEE ARTICLES ON ST. LAWRENCE SEAWAY.

National Prestressed Pools



One of the largest motel swimming pools under construction at the Blue Spruce Motel, Murrysville, Pa.

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The NATIONAL POOL package includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and complete filter system. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed pre-cast interlocking concrete wall sections fit into each other and solves cost problem. Pool walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets.

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National Pre-stressed pool installed at Glenn Motor Court, Watkins Glenn, N. Y

NATIONAL

pool equipment co.

Lee Highway **Florence, Alabama** **Atwater 2-1620**

Greenville, S.C. Builds for 1990 with CLAY PIPE

The new sewerage program now underway in Greenville looks far into the future of this fast-expanding area. Existing main and outfall sewers are being paralleled by larger ones designed to serve the community until 1990, or until the present 130,000 population has grown to 233,000. Greenville is following the pattern of hundreds of other cities which are building for the future by specifying the *guaranteed* pipe—Vitrified Clay. The total project will cost $3,500,000.

"Because of the character of the wastes handled and expected to be handled by the sewers," reports Superintendent E. D. Fry of the Greater Greenville Sewer District Commission, "it is the policy of the Commission to use Vitrified Clay Pipe wherever possible and to require it to be used by the subdivisions of the sewer district." Clay Pipe is the *only* pipe that *never wears out*.

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Contractors—**A. H. Guion & Co., Peden Construction Co., Glenn Construction Co.**
Greater Greenville Sewer District Commission—**E. D. Fry, *Supt.***

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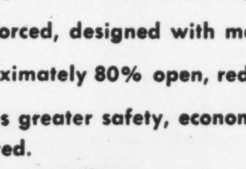

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CIVIL ENGINEERING

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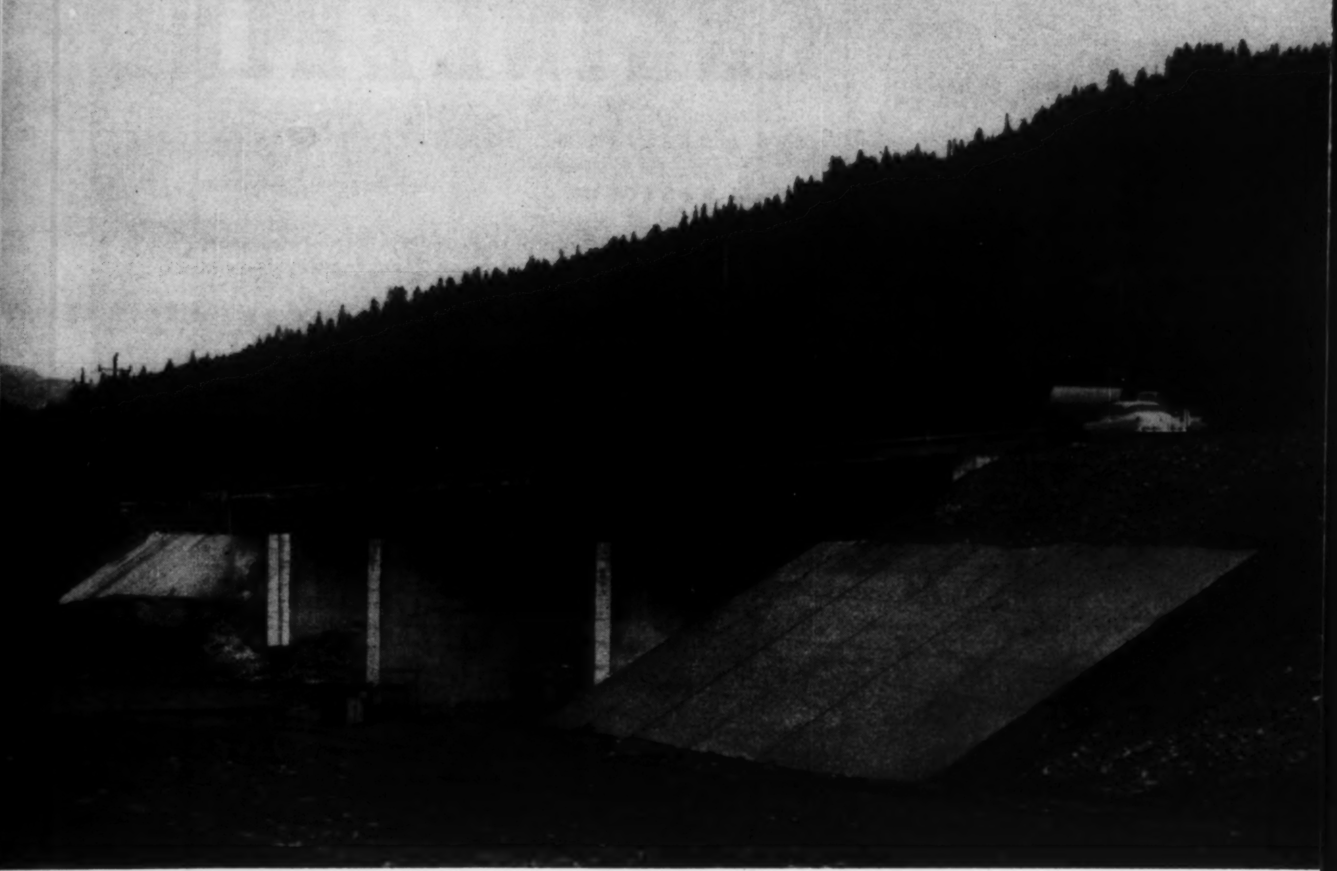
620′ 4-span Highway Bridge

by AMERICAN BRIDGE



THIS MODERN STEEL STRUCTURE replaces the original Trinity River Bridge near Hoopa, Humboldt County, California, which was washed out during the December 1955 floods, and the emergency bridge erected to temporarily serve through the following spring and summer.

This new permanent structure is a 4-span welded plate girder cantilever bridge 620′ long and provides a 28′ roadway. The bridge consists of girders, bracings, cross frames, expansion devices, fabreeka pads, anchor bolts, catwalk pipe rails and pier armor, all of which was fabricated and erected by American Bridge.

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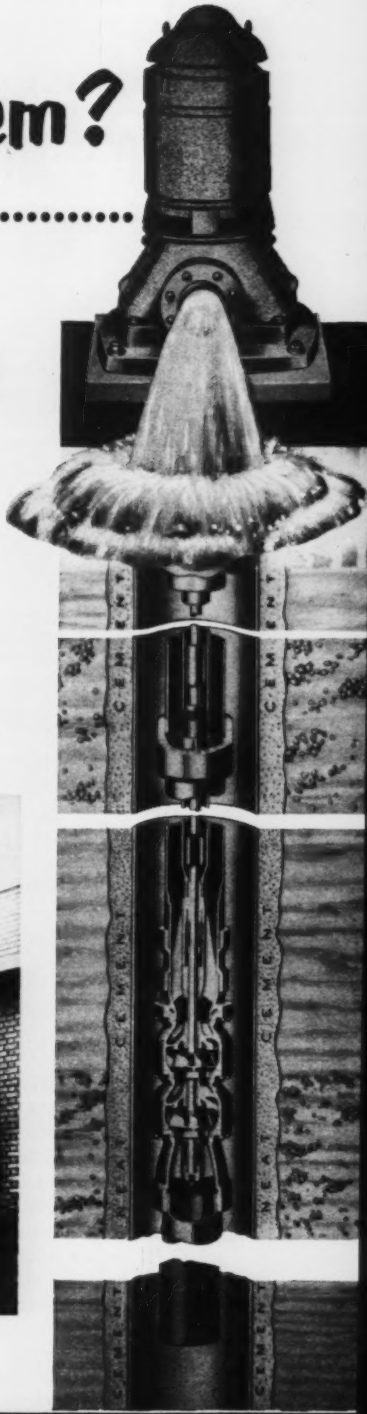

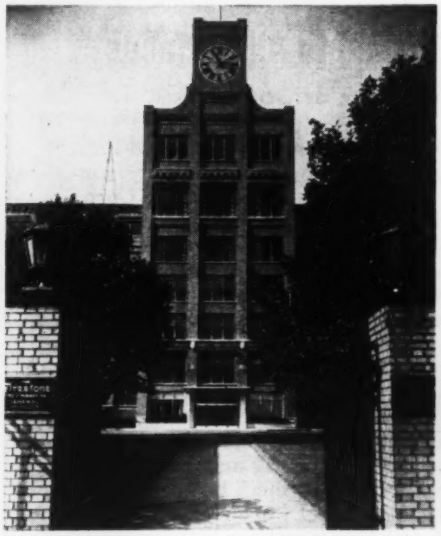

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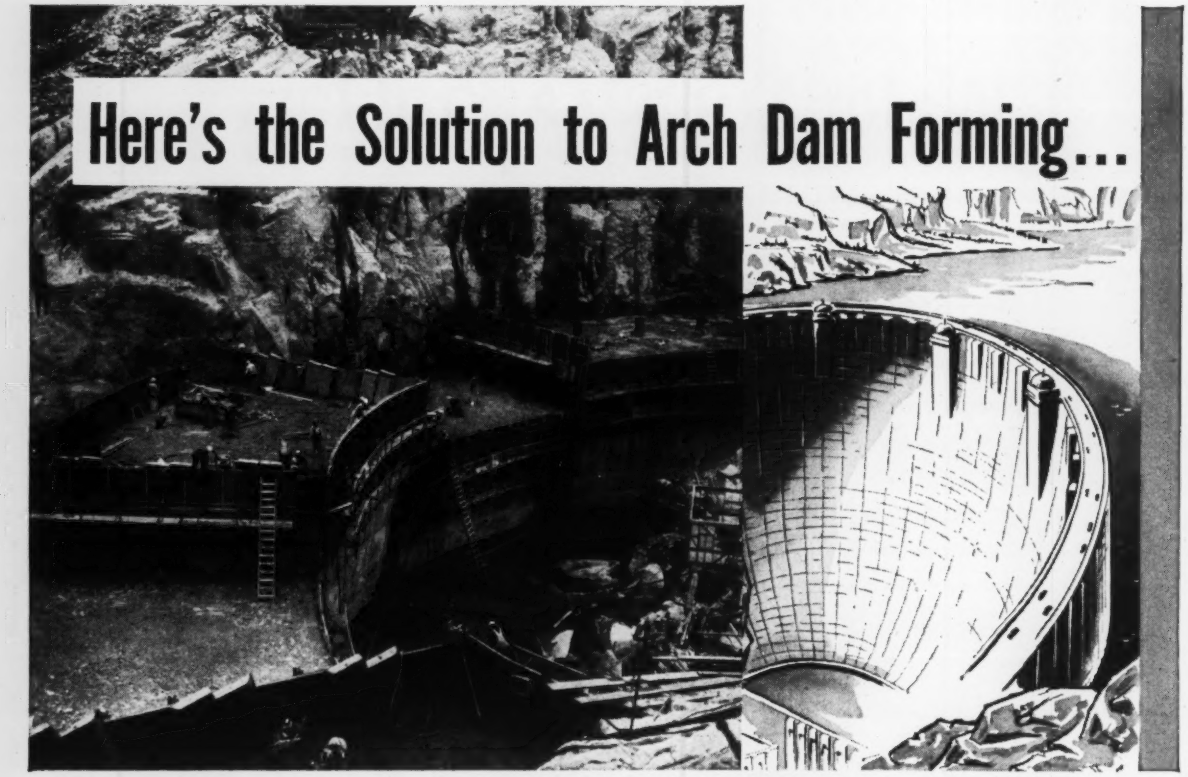

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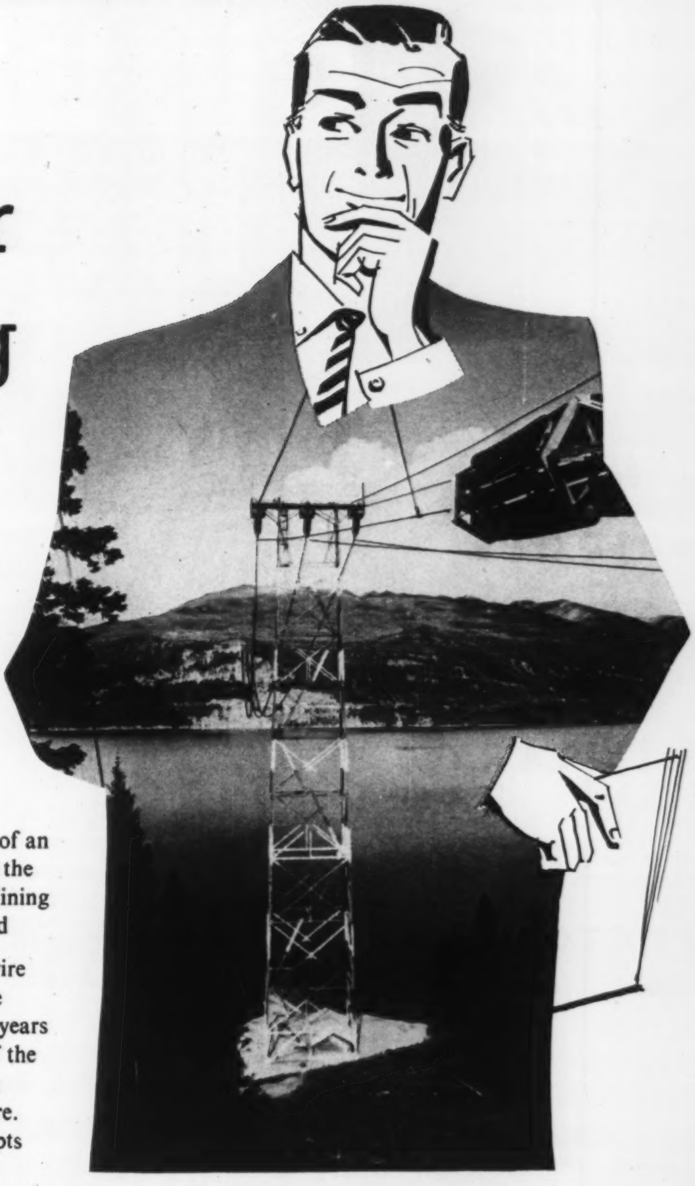
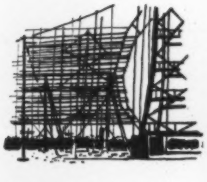


Across Kootenay Lake in British Columbia stretches one of the longest single suspension spans in the world. Roebling fabricated the high-strength conductors. Two miles in length, it is part of an 87-mile power transmission line connecting the power plants and mine of Consolidated Mining and Smelting Company of Canada, Limited

All structures and systems supported by wire members are of interest to Roebling, whose activity in this field goes back many, many years and is steadily increasing in scope. Some of the suspension applications on which Roebling has served in whole or in part are shown here. Within each of these categories, new concepts of design and operation do and *can* exist.



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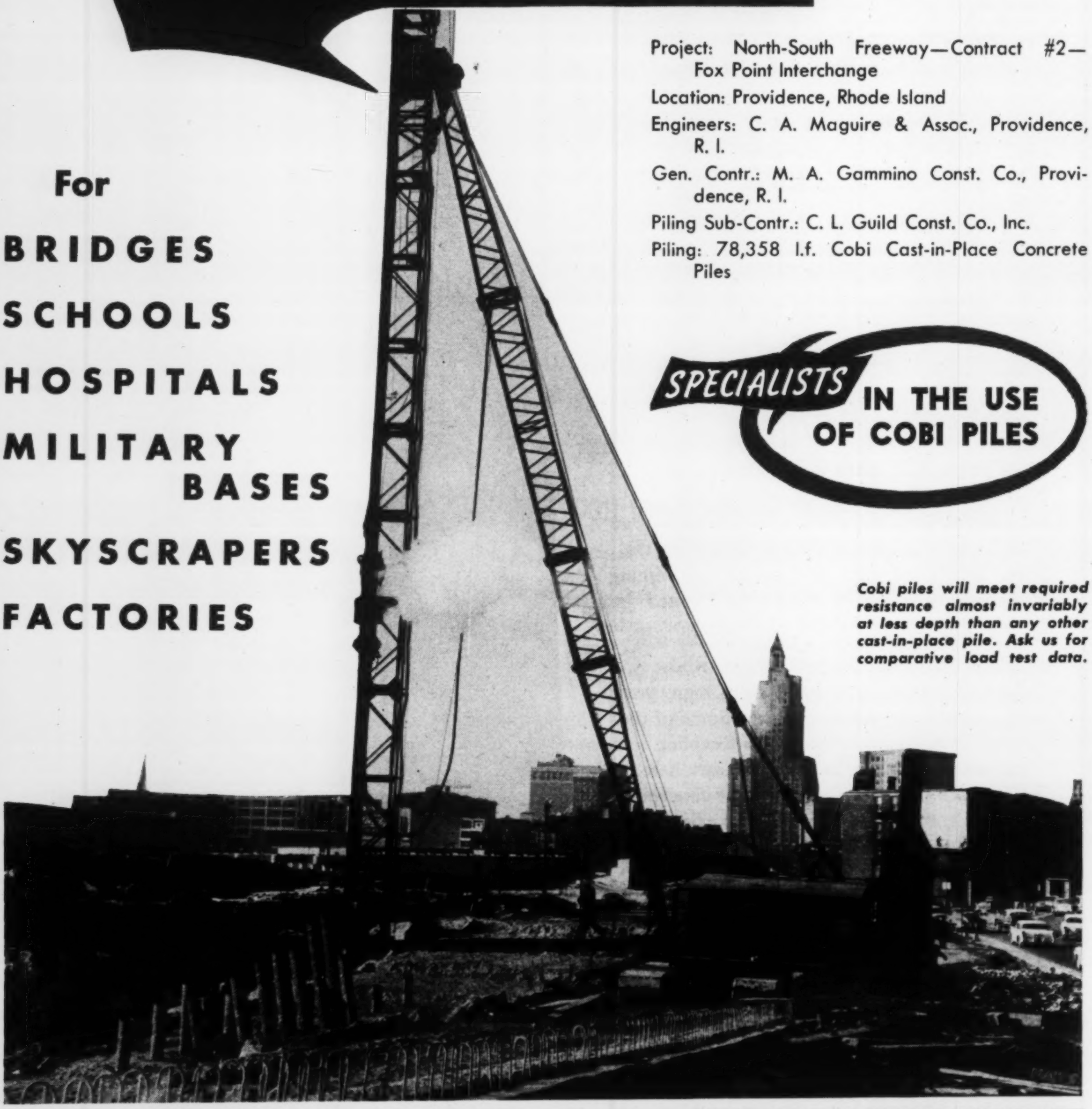

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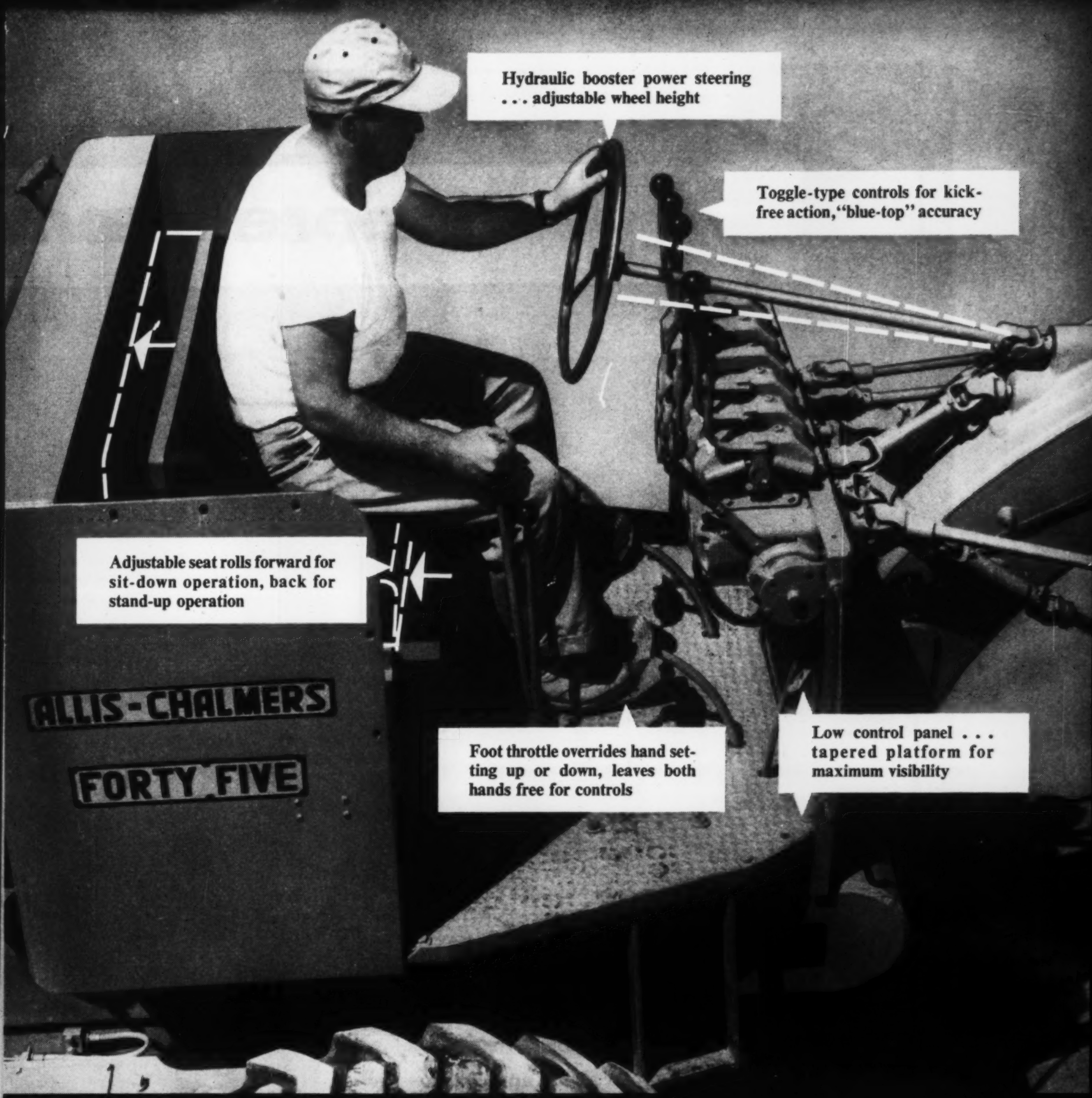

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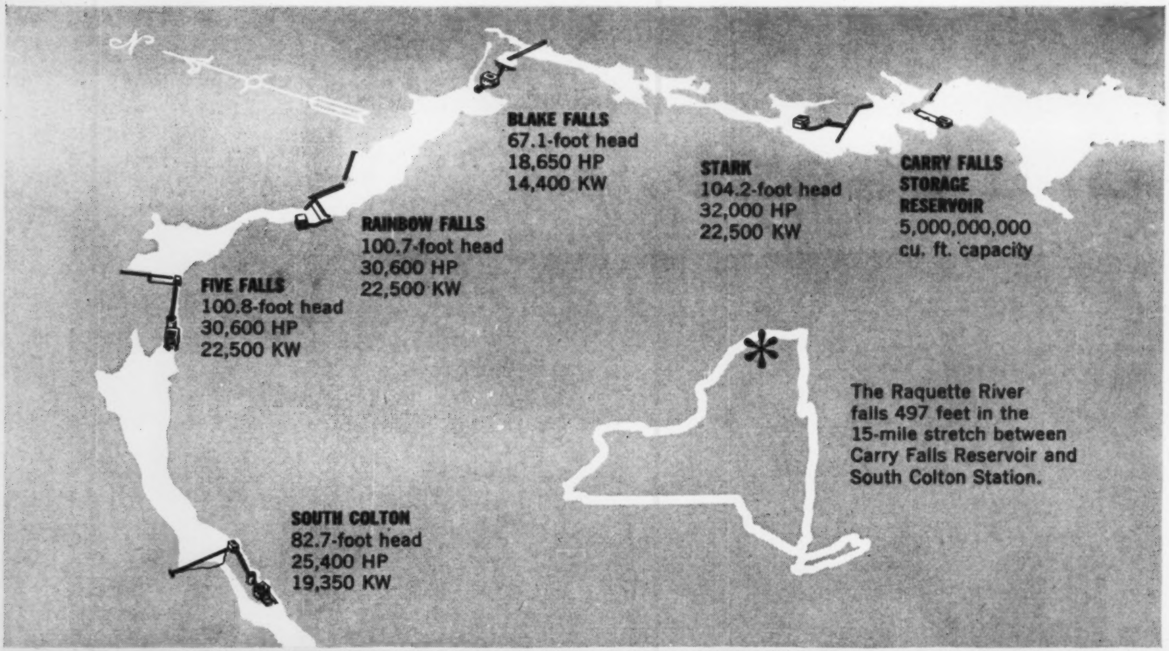
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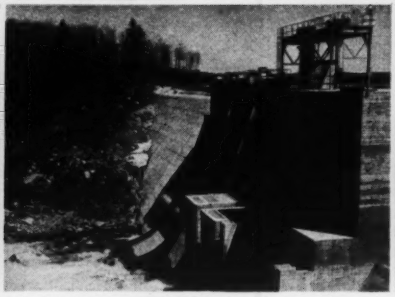
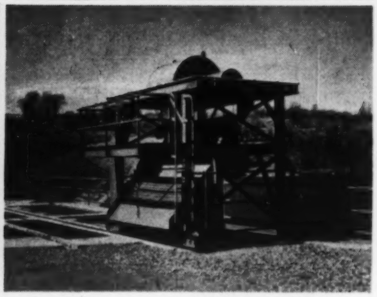
The Raquette River falls 497 feet in the 15-mile stretch between Carry Falls Reservoir and South Colton Station.

South Colton powerhouse is typical of all 5 unattended stations. Supervisory control of automatic operation will be from Colton, 7 miles downstream.



Two SMS sliding gates with 50,000-lb. twin-drum cable hoists at Carry Falls Dam are designed for free discharge under a 58-foot head. This site can be converted to a hydro plant later if desired.



SMS self-dumping trash rakes operate directly on rack bars, ride down over obstructions and work them loose with a freedom of movement that assures fast, easy cleaning.

5 New Stations On Raquette River Equipped with SMS TURBINES AND ACCESSORIES

To further harness the Raquette River in northern New York, the Niagara Mohawk Power Corp. is now completing a series of five new power plants and a large storage reservoir. Each of these automatic, peak-load stations is equipped with an SMS-Francis turbine. SMS intake gates and twin-drum cable hoists, as well as trash rakes, are also used.

Working in close conjunction with Niagara Mohawk's engineers, SMS used two runner designs in the same basic wheel case for all five units. One runner design was used for the lower head turbines at South Colton and Blake, while another was used for the higher head turbines at Five Falls, Rainbow and Stark. This meant initial economy, and will provide operating and maintenance savings.

Each of the three lower stations uses self-dumping trash rakes at the turbine inlets. This design makes operation quicker and easier, cleans a greater area faster. For full information on these new trash rakes, or on other SMS accessories and hydraulic turbines, write S. Morgan Smith Co., York, Penna.

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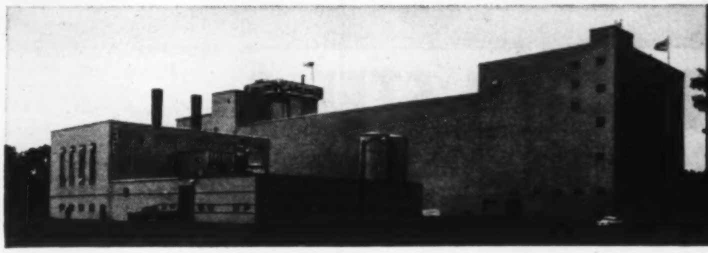

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The Jefferson City Bridge was singled out for honorable mention by the American Institute of Steel Construction as among the most beautiful bridges* opened for traffic in 1955. This span across the Missouri River is typical of the more than 95 major bridges that have been built with USS High Strength Steels in the past four years.

The 3093′9″-long Jefferson City Bridge features a three-span continuous-tied arch unit with spans measuring 416′, 640′ and 416′. At present it carries a 28′ roadway flanked by two 5′ sidewalks inside the trusses, but sidewalks eventually can be moved outside the trusses to expand the roadway to 38′. USS Tri-Ten "E" Steel is used in trusses, web members and expansion devices.

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This not only saved weight, thus saving steel and reducing transportation and erection costs, but resulted in even more important secondary savings. The smaller steel sections used, by decreasing the dead load and lessening the wind area, made it possible to reduce the size—and cost—of the piers and shafts.

Here again, as in other important bridges built with USS High Strength Steels, the resultant accumulated savings add up to important cost reductions. (In some cases these have run as high as 15% of the cost of the structure.)

For further information on ways that USS Tri-Ten "E" and other USS High Strength Steels—USS Man-Ten and USS Cor-Ten—can be incorporated in your designs to provide maximum strength, safety and durability with a minimum of weight and costs, send for a copy of our "Design Manual for High Strength Steels." Write on your company letterhead to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

**The prize-winning "most beautiful" long span bridge—the Missouri River Bridge at Leavenworth, Kan.—was also built with* USS Tri-Ten *"E" Steel.*

◀ **The Jefferson City-Missouri River Bridge**

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Design—Sverdrup & Parcel, Inc., St. Louis, Mo.
Fabrication—Truss span by Stupp Brothers Bridge and Iron Company, St. Louis, Mo. Approach superstructure by Pacific Bridge Company, San Francisco, Calif.
Erection—John Beasley of Dallas, Texas

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24 YEARS OF PERFORMANCE

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Mr. Evan Evans (right) and Mr. Clarence Dankel (left)

"Our 30-in steel pipe is going strong after 25 years"

(Report of an interview with Evan Evans, president, and Clarence Dankel, general manager, Panther Valley Water Company, Lansford, Pa. In 1932 this company constructed a 30-in.-ID steel pipe line nearly 10 miles from Still Creek dam to Coaldale. The pipe was fabricated in 30-ft lengths by Bethlehem Steel Company. It was lined with 3/32-in.-thick Bitumastic enamel, and is thought to have been the country's first large steel water main to be enamel-lined centrifugally. Engineers were Gannett, Seelye & Fleming, now Gannett, Fleming, Corddry & Carpenter, Inc., Harrisburg, Pa.)

Q. Mr. Evans, is the Still Creek line in service today?

A. Yes, it's been used continuously since 1932, carrying about 15,000,000 g.p.d.

Q. How about the flow capacity?

A. The average "C" as determined by our flow tests in 1933 and in 1940 was about 145. I'd say that the flow capacity is just about as good as ever today. There has been no damage to the tar enamel lining as far as I know.

Q. Has the pipe ever failed in any way?

A. No, and it's quite amazing. During the flood caused by hurricane Connie in 1955 the cover was completely swept away from about 1000 ft of the pipe. In many places the pipe spanned 50 or 60 ft without any support whatsoever. Yet there wasn't even the trace of a failure. What's more, the line runs right through our worst areas of subsidence due to mine cave-ins. Still no trouble with the pipe.

Q. What kind of soil is the pipe laid in?

A. Just about the worst you could find. It's "hot" soil; lots of coal banks and the like. But it hasn't damaged the pipe.

Q. Then you're satisfied with performance of the line?

A. Definitely. We're well pleased in every respect.

Would you like to have more information about Bethlehem Tar-Enameled Steel Pipe? Please contact the Bethlehem sales office most convenient to you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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BETHLEHEM STEEL

NEWS OF ENGINEERS

Daniel V. Terrell, Past-President of ASCE, is retiring as dean of the University of Kentucky College of Engineering after eleven years in the post. During his 45-year tenure with the university, Dean Terrell has been responsible for such accomplishments as establishing its Highway Scholarship Program, which cooperates with the State Highway Department and industry in financing the training of a number of students; the Engineering Experiment Station, of which he has been director for the past eleven years; and the Department of Chemical and Agricultural Engineering. He will continue to serve as consultant to the Kentucky Highway Department. A former Director and Vice-President of ASCE, Dean Terrell was instrumental in establishing the District 9 Council.

Dean Terrell

Charles C. Zollman and Associates, consulting engineers, announce the removal of their offices to 3605 Chapel Road, Newtown Square, Pa.

Stanley I. Corman, superintendent for the Robert R. Anderson Company, Chicago, Ill., has formed the Corman Paving Company, Inc., of which he is president. The firm deals with all types of paving and related work. It will have its headquarters in Chicago.

John M. Kyle, chief engineer of the Port of New York Authority, has been awarded the organization's Distinguished Service Medal for his role in directing the design and construction of the $100 million Third Tube of the Lincoln Tunnel. The award was presented at the recent dedication ceremonies. Mr. Kyle was cited "for the engineering skill, the energy, and the limitless time he has given to it; and for the burden of responsibility he has carried throughout the job." Mr. Kyle joined the Port Authority in 1946 as assistant to the chief engineer.

John M. Kyle

Two ASCE members have been elected officers of the Pollution Control Council, Pacific Northwest Area. They are **Curtiss M. Everts, Jr.,** elected chairman, and **Herbert C. Clare,** re-elected secretary. The elections were held at a recent joint conference in Olympia, Wash., of the Pollution Control Council, Pacific Northwest Area, and the Subcommittee on Water Supply and Water Pollution Control of the Columbia Basin Inter-Agency Committee.

Eivind Hognestad, manager of Structural Development for the Portland Cement Association, Chicago, Ill., has been made technical director of the Marquette Cement Manufacturing Company, with headquarters in the same city. In his new position Dr. Hognestad succeeds **Charles E. Wuerpel** who will now supervise technical operations. In 1955 Dr. Hognestad was co-recipient of the Society's Research Prize "in recognition of outstanding work in research in structural concrete." In the same year the American Concrete Institute awarded him the Leonard C. Wason Medal for noteworthy research.

James E. Baldwin, president of the Baldwin Engineering Company, Augusta, Ga., has moved his office from 840 Reynolds Street to larger quarters at 843 Greene Street.

Marion A. Dillingham, since 1950 principal civil engineer for the Ambursen Engineering Corporation, consulting engineers of Houston, Tex., and New York City, has been made vice-president of the firm. In addition, he has been appointed general manager of the Houston office. Before joining the Ambursen Corporation, Mr. Dillingham was connected with the Corps of Engineers at Galveston and Fort Worth.

Abel Wolman retired last month as professor of sanitary engineering at Johns Hopkins University, Baltimore, Md. He will head a special committee studying the educational objectives of the School of Hygiene and Public Health. Professor Wolman's many activities include membership on the Atomic Energy Commission's Reactor Safeguard Committee and its Safety and Industrial Health Advisory Board, and as consulting engineer to Baltimore's Department of Public Works. A former president of the American Water Works Association, he is also active on its Committee on National Water Policy. In 1948 he received the APHA's Sedgwick Memorial Award, which cited him for ". . . a generous and wise giving of himself to causes larger than himself . . ."

(Continued on page 20)

45° A NEW SERIES AURORA® TYPE A
Two Stage Diagonally Split Case
MULTI-PURPOSE PUMPS 45°
Suited to BOILER FEED, Hot or Volatile Liquids duties etc., etc.
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Low NPSH Characteristics
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Type A centrifugal basic pump. Suction and discharge in lower half of casing.

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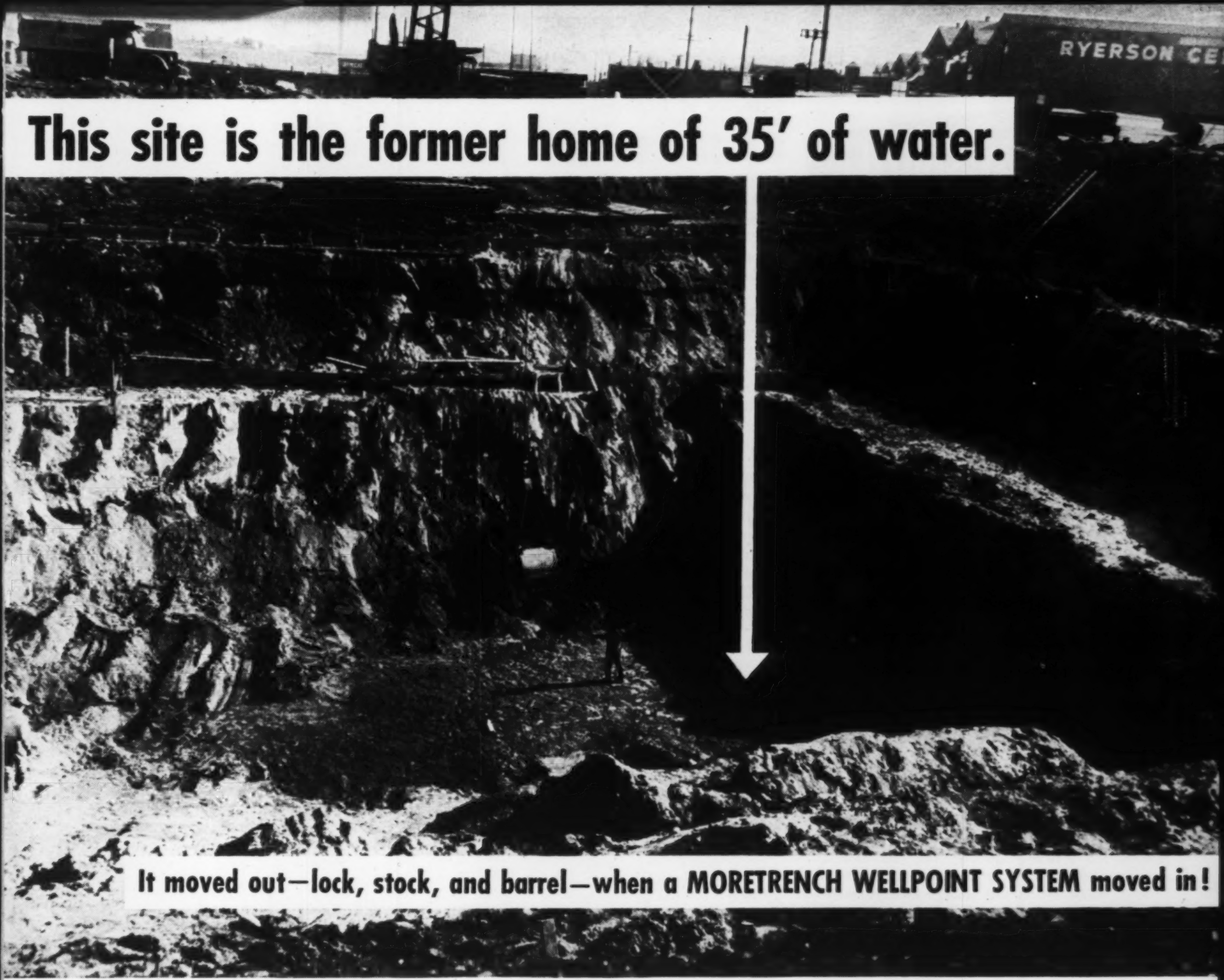

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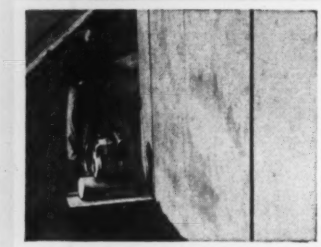

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News of Engineers

(Continued from page 18)

Edwin M. Eads, Colonel, U.S.A.F., Air Force Installations Representative, South Pacific Region, San Francisco, Calif., has been awarded the 1956 Newman Medal of the Society of American Military Engineers, "for his surveillance of Air Force construction in the region, which has provided facilities embodying the best in design and construction to meet operational requirements." The medal was presented at SAME's 37th annual meeting and dinner held in Washington, D. C., in May.

Edward F. Eldridge, since 1948 director and chief engineer for the Washington Pollution Control Commission, Olympia, Wash., has been appointed special research assistant in the Water Supply and Water Pollution Programs of the U. S. Public Health Service. Mr. Eldridge is in the Pacific Northwest office of the Service in Portland, Ore.

J. Stephen Watkins, consulting engineer of Lexington, Ky., has opened a new branch office at 4724 Preston Highway, Louisville, Ky., under the resident direction of **C. W. Lovell,** project engineer. The new office will handle highway engineering work. Recently the firm opened branch offices in Lansing, Mich., and Charleston, W. Va.

Two Society members received honorary doctor of engineering degrees from Clemson College during its recent commencement exercises. Cited were **Allen Stanley Bedell,** chairman of the Board of Directors for the J. E. Sirrine Company, Greenville, S. C., and **Robert C. Blair,** manager of the Savannah River Operations office of the U. S. Atomic Energy Commission.

David B. Steinman is first recipient of the George W. Goethals Medal of the Society of American Military Engineers for his achievements symbolized by the design and construction of the Mackinac Bridge. The honor was presented to Dr. Steinman at SAME's annual dinner held in Washington, D. C., in May.

John F. Brennan, chief engineer for Dames & Moore, soil mechanics engineers of Los Angeles, Calif., has been made a resident partner in the firm's New York City office.

Richard L. Hearn, general manager and chief engineer of the Hydro Electric Power Commission of Ontario, has been awarded the Sir John Kennedy Medal of the Engineering Institute of Canada for "outstanding merit in the profession." The medal was presented at the Institute's annual meeting held at Banff Springs, Alberta, in June.

Carl G. Paulsen retired in April as chief hydraulic engineer for the U.S. Geological Survey, Washington, D. C., after almost 45 years on the Survey staff. Mr. Paulsen will continue to serve as Delaware River Master under a decree of the United States Supreme Court and also in a special advisory capacity on a number of international water commissions. He recently completed a term as Director of ASCE. **Luna B. Leopold** will succeed Mr. Paulsen as chief hydraulic engineer. He became connected with the Survey staff in 1941, and for the past ten years has been district engineer of the Ground Water Branch in Idaho.

Carl G. Paulsen

William A. Kiehnle, president of the William V. Kiehnle Co., New York City builders and engineers, has been made a member of the New Rochelle (N. Y.) Board of Standards and Appeals. He has lived in New Rochelle for the past 23 years.

William J. Eney, head of the civil engineering department at Lehigh University, received the $2,000 Hillman Award, the university's highest faculty honor, at the tenth annual Faculty Dinner. Professor Eney, who also heads the Fritz Engineering Laboratory at Lehigh, was cited as "the member of the Lehigh faculty who has done the most toward advancing the interests of the university." Since joining the Lehigh faculty in 1936, Professor Eney has initiated a varied research program in the Fritz Engineering Laboratory including pioneer work in prestressed concrete.

John S. H. Chapman, structural engineer for Crout, Snyder & Crandall, Baltimore, Md., has joined the Benjamin E. Beavin Company, consulting engineers and surveyors of Baltimore.

Chas. P. Morgan & Associates, Inc., engineers, and Morgan & Adams, Fred G. Adams, Architect, announce the change in the firm's name to Adams, Morgan, Latham, Kripp & Wright, Architects & Engineers. Associates in the firm are G. Scott Robertson, Jr., Jean R. Cook, and George K. Kobayashi. They will maintain the same offices in Long Beach, Calif.

Marshall McCord, chief of the Structures Section for Green Associates, Baltimore, Md., has been named chief civil engineer of the firm. Prior to his connection with Green Associates, Mr. McCord was with the J. E. Greiner Company of Baltimore.

Allen P. Richmond, Jr., who retired in May as Assistant to the Secretary of ASCE, was initiated as a Chapter Honor member of Chi Epsilon Fraternity at recent ceremonies held at Cooper Union in New York. Other members similarly honored are **Clinton D. Hanover,** District 1 Director and consulting engineer with Hardesty and Hanover, New York, who was initiated by the Yale Chapter; and **William S. LaLonde,** chairman of the civil engineering department at Newark College of Engineering, initiated by the M.I.T. Chapter. Chi Epsilon, national honor society for civil engineers, installed its 49th Chapter at the University of Hawaii this spring.

A. P. Richmond

Robert D. Austin, since 1937 engineer for the U.S. Bureau of Reclamation, Yuma, Ariz., has become chief of the Engineering and Hydrology Branch for the Bureau's Region 3 Project Development Division staff in Boulder City, Nev. His new duties will include studies and investigations of potential Reclamation developments in Region 3. Mr. Austin has been connected with such notable USBR projects as the All-American Canal Project and the Imperial Dam.

Charles M. Noble, former chief engineer for the New Jersey Turnpike Authority, New Brunswick, N. J., has been cited by the Authority for "his superb performance in a position of major responsibility; for his initiative and resourcefulness, and for the valued services rendered to the members of the Authority, and its staff, and the State of New Jersey in the design and construction of the Turnpike." Mr. Noble served as chief engineer of the Authority from its inception early in 1949 until January 1957 when he left to become associated with the Ohio Department of Highways (February issue, page 27).

Sidney F. Borg, head of the civil engineering department at Stevens Institute of Technology, Hoboken, N. J., has been awarded a National Science Foundation grant, enabling him to attend the Seventh Congress of the International Association for Hydraulic Research in Lisbon, Portugal, July 2-10. While there Dr. Borg will present a paper, "Cavitational Effects in Unsteady Two and Three Dimensional Flows."

Louis J. Rumaggi, Brigadier General, since May 1955 Chief of Staff, Sixth Army, Presidio of San Francisco, Calif., will become Central Division Engineer, Army Corps of Engineers, Chicago, on July 15. In his new assignment General Rumaggi succeeds **Brig. Gen. Paul D. Berrigan,** Division Engineer since 1955, who is retiring. Prior to his appointment as Chief of Staff for the Sixth Army, General Rumaggi was Deputy Chief of Engineers for Military Operations in Washington, D. C.

Leon E. Andrews has retired as regional highway engineer for the Portland Cement Association, New York City, and is now transportation and traffic engineer with the Civil Defense Planning Agency, Trenton, N. J.

Lynn S. Beedle, associate professor of civil engineering and chairman of the Structural Metals Division of the Fritz Engineering Laboratory at Lehigh University, Bethlehem, Pa., has been promoted to full professorship.

Clarence C. Burger, chief of the operations division for the Office of the Chief of Engineers, Washington, D. C., has been transferred to New York City as special assistant to Colonel Clarence Renshaw, North Atlantic Division Engineer. Mr. Burger has been in the Corps of Engineers since 1926, serving 19 years in the Office of the Chief of Engineers.

W. H. Hudson, since 1954 assistant general manager for the St. Louis Southwestern (Cotton Belt) Railway Lines, has been promoted to vice-president and general manager of the railway. Mr. Hudson has been connected with the line since 1926.

Paul D. Troxler, Colonel, Corps of Engineers, for the past three years staff supervisor for the Engineering Division in the Office of the Chief of Engineers, Washington, D. C., has become district engineer for the Corps at Jacksonville, Fla. In his new assignment Colonel Troxler succeeds **Col. Elmer E. Kirkpatrick, Jr.**

Cecil M. Trent, since 1954 senior designing engineer for the Texas State Highway Department, Houston, has joined the firm of Tellepsen Petro-Chem Constructors of Houston. Mr. Trent became connected with the Houston District of the Texas Highway Department in 1947.

Four Society members were among participants from the United States in the Sectional Meeting of the World Power Conference held in Belgrade, Yugoslavia, June 5-11. They were ASCE Past-President **Gail A. Hathaway,** Hyattsville, Md.; **Donald H. McCoskey,** Dallas. Tex.; **Edwin G. Nielsen,** Washington, D. C.; and **Francis L, Adams,** Washington, D. C. Mr. Adams, who is chief of the Bureau of Power of the Federal Power Commission, was official government delegate.

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RECENT BOOKS

(added to the Engineering Societies Library)

The Analysis of Engineering Structures
Third Edition, 1957

As in previous editions the primary object is to present to the engineering student a general outline of the theories upon which the design of structures is based. Some items and materials dealt with include: straight and curved beams; elastic bodies; redundant frames; reinforced concrete; the suspension bridge; influence lines; the voussoir arch; steel framed buildings; masonry dams; retaining structures; and plastic theory. (By A. J. S. Pippard and J. F. Baker. Edward Arnold, Ltd., London, England. Distributed by St. Martin's Press, Inc., 103 Park Avenue, New York 17, N. Y. 564 pp. $15.00.)

Disposal of Industrial Waste Materials

These papers deal with waste treatment in a number of industries including the pharmaceutical, pesticides, leather, rubber, resins, paints and varnishes, textiles and paper, ceramic, iron and steel, non-ferrous metals, electroplating and petroleum industries. The problems, origin, treatment for re-use and recovery of valuable material and the final disposal of both liquid and solid residues are discussed. There are two papers on the disposal of industrial atomic wastes and the industrial uses of fission products. (Papers read at a Conference, April 1956. Society of Chemical Industry, London, England, 1957. 157 pp. $7.50. Available in the United States from Macmillan Co., 60 Fifth Avenue, New York 11, N. Y.)

Elementary Theory of Structures

In this text—by Chu-Kia and Clarence Lewis Eckel—special emphasis is placed on step-by-step examples for the illustration of every method and principle discussed. Subjects covered include algebraic and graphic methods of solving problems in equilibrium of coplanar force systems, shears and bending moments in beams, stresses in roofs and trusses, analysis of building bents, analysis of highway and railway bridges, three methods of analyzing statically indeterminate structures: the consistent deformation, the slope-deflection and the moment-distribution method. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1957. 387 pp. $7.50.)

Engineering Enrollment in the United States

Presents basic statistics on the subject in both tabular and graphic forms. The period covered varies but generally includes the last 25 to 35 years. In addition to general coverage there are chapters on all major fields of engineering, and one chapter on engineering training in Russia. Considers the effects of proliferation of curricula in engineering specialties, large-scale enrollment in graduate study, and attrition of engineering students. Concludes that the current shortage of engineering talent is critical with respect to engineers with a high degree of mathematical and scientific orientation and those with unusual analytic and design creativity. (Edited by Norman N. Barish. New York University Press, New York 3, N. Y., 1957. 226 pp. $7.50.)

Hilfstafeln Zur Berechnung Wandartiger Stahlbetontrager

Tables and graphs for the design of deep panel-type reinforced-concrete girders as used in silos and bunkers. The accompanying text provides the theoretical basis, analyses of loads, the form and reinforcement of panel-type girders, and three examples of calculations. (By Otto Theimer. Wilhelm Ernst & Sohn, Berlin-Wilmersdorf, Germany, 1956. 38 pp. DM 7.20.)

Hydraulics of Multiple Mains

A book that will serve somewhat as a manual or handbook for engineers employed in enlarging or modernizing an inadequate water supply system. There are sections on classification and design of mains, basic equations for fundamental hydraulics, relative rates of flow for feeder mains, and pipe lines in series and in parallel. The concluding chapters give material on additional pipe lines, the life of the system and typical problems. The appendix contains nomographic charts. (By Oscar G. Goldman. Columbia Graphs, Columbia, Conn., 1957. 145 pp. $6.50.)

Manual on Industrial Water
Special Technical Publication No. 148-B

In addition to a comprehensive discussion of the uses, treatment, sampling, analysis, and difficulties caused by water, the Manual contains a complete appendix listing ASTM standards relating to industrial water. Five methods of sampling, 41 standards, four methods of analysis, three standards for reporting results, six standards for methods of testing, a glossary of terms, a list of industrial water requirements, and a bibliography are included. Among these are seven new methods and one important revision. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 492 pp. $6.00.)

Ten-Division Influence Lines for Continuous Beams
Eighth Edition, 1956

An English translation of Vol. 3 of the original German work, covering ordinates of influence lines and of moment curves for continuous beams, with separate sections for 1 to 5 spans; it also gives influence coefficients of cantilever moments. A 30-page introduction explains the use of the detailed tables in the analysis of the structural forms involved. (By Georg Anger. Frederick Ungar Publishing Co., 105 East 24th Street, New York 10, N. Y. 247 pp. $9.50.)

(Continued on page 112)

FROM THE FILES OF DR. CENTRILINE...
"Hmmm-Leakage! This calls for immediate consultation"

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PATIENT: 5 miles of 62" and 36" steel water mains in St. Louis, Missouri.

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*From a paper written by Mr. John B. Dean, Division Engineer, Water Div., St. Louis, Mo.

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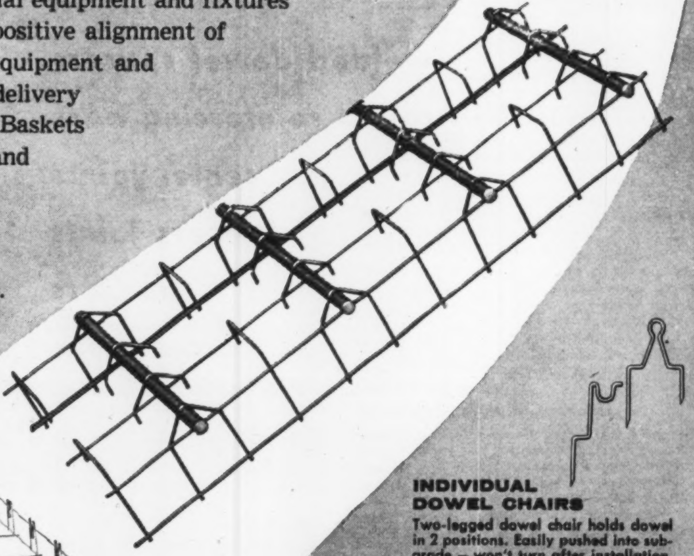

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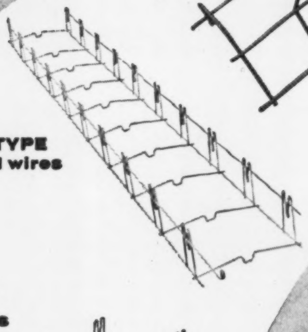
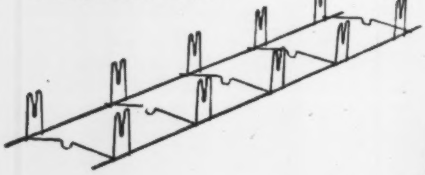


STANDARD TYPE
4 longitudinal wires



STANDARD TYPE
2 longitudinal wires

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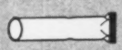

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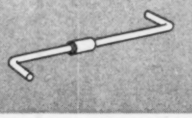

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Worm's-eye view looking up through safety net to boom tower used during erection of CB&I surge tanks at Garrison Dam.

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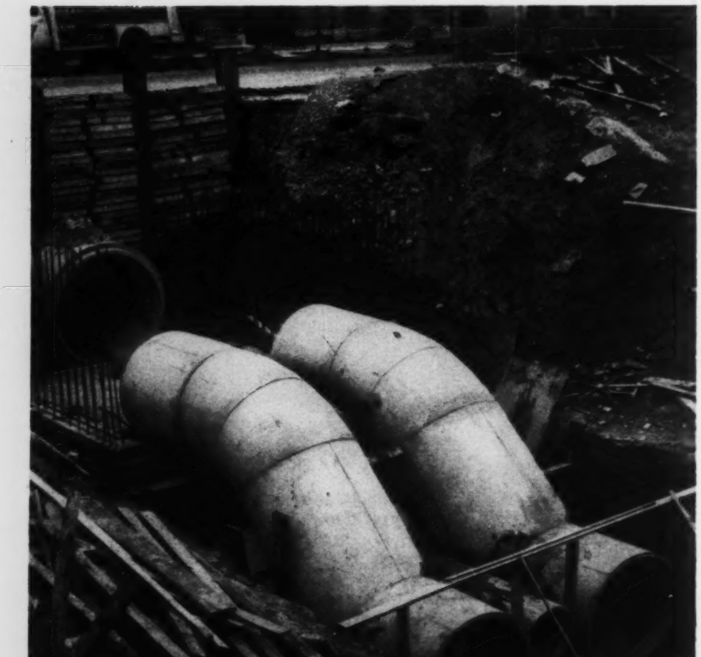

Now nearing completion, the Congress Street Expressway extends west for about eight miles from downtown Chicago. Since most of the expressway is depressed below existing north-south streets, inverted siphons were required to supplement an existing and relocated 78-inch diameter combination sewer.

Two lines of 54-inch and one line of 24-inch diameter were constructed of reinforced concrete pipe in 12-foot lengths for the Cook County Highway Department. The smaller line will convey normal dry weather flow. During prolonged rainfall, when the existing 78-inch diameter sewer may flow full or under slight pressure, the two large pipe lines will also carry sewage under the expressway.

The reinforced concrete pipe and the Y-branches and bends were made to exact dimensions and the joints sealed with rubber gaskets by the American-Marietta Company.

Our technical staff will be pleased to assist you with your pipe problems.

Another example of PROGRESS IN CONCRETE

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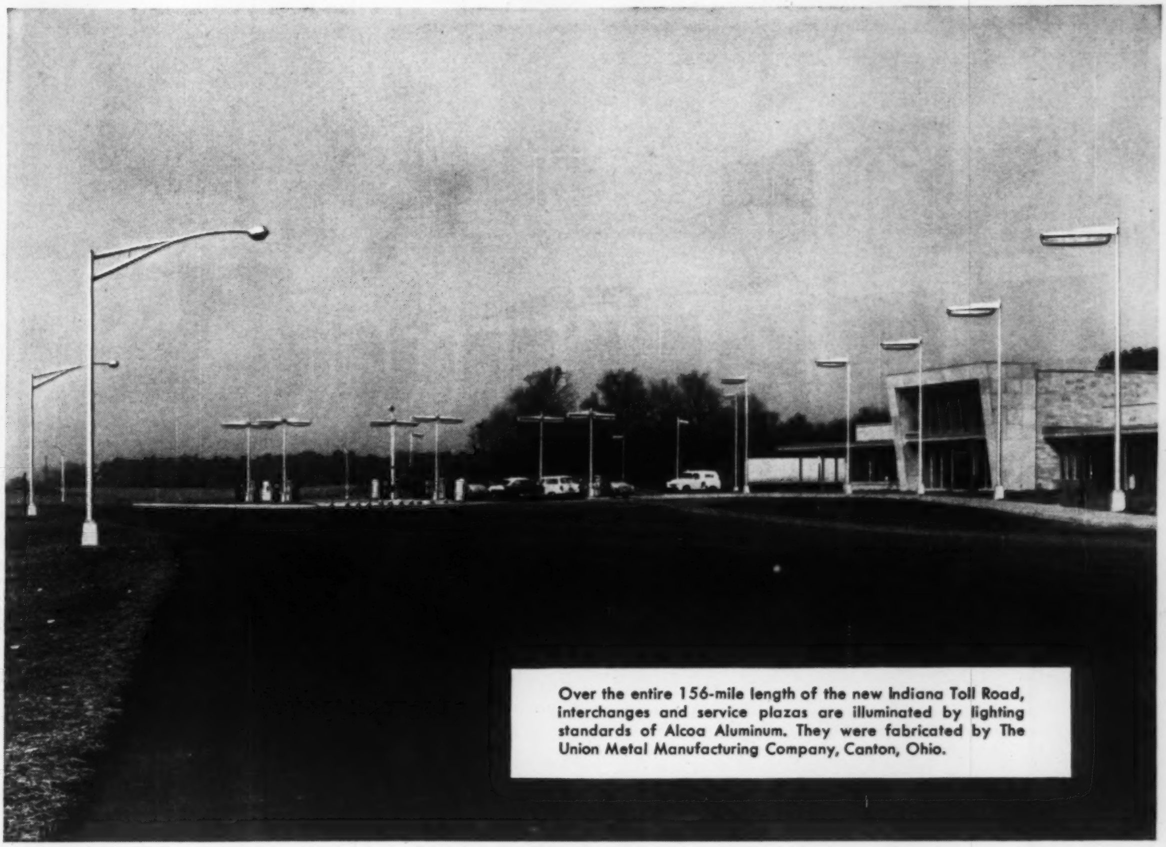

Over the entire 156-mile length of the new Indiana Toll Road, interchanges and service plazas are illuminated by lighting standards of Alcoa Aluminum. They were fabricated by The Union Metal Manufacturing Company, Canton, Ohio.

HERE'S WHY 1,700 LIGHTING STANDARDS ON THE INDIANA TOLL ROAD WILL NEVER NEED PAINTING

The answer, of course, is Alcoa® Aluminum! Lighting standards made of Alcoa alloys defy corrosion, both inside and outside. As a result, wall strength remains constant and poles keep their attractive appearance for life without any need for expensive, protective painting.

Savings mount in other directions, too. Aluminum standards weigh less than half as much as those of other materials, so they're less costly to ship, handle and erect. Yet there is no sacrifice of needed strength. Poles made of Alcoa Aluminum have withstood wind loading in excess of 100 mph. In fact, no wind damage to an aluminum lighting standard has ever been reported.

Add up the economies that start with faster, easier installation and increase year by year through elimination of painting. Then, if you plan to buy lighting standards, write us for the names of leading manufacturers who make them of Alcoa Aluminum. Aluminum Company of America, 1979-G Alcoa Building, Pittsburgh 19, Pa.

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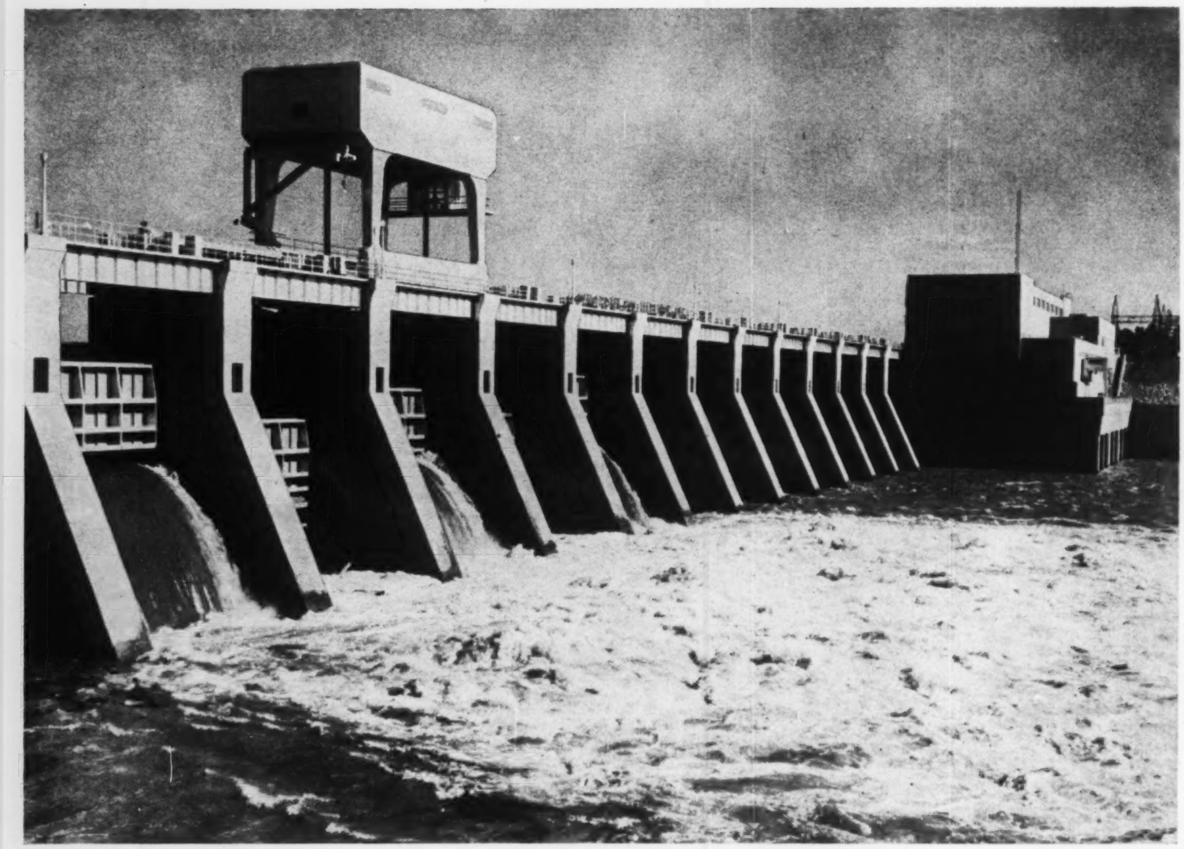

Florida's Jim Woodruff Dam...

Built 100% of Ideal Cement Concrete

...Creates a New Lake, a New Waterway, and a New Source of Electric Power

The recently completed Jim Woodruff Dam at Chattahoochee, Florida, is a prime example of the way concrete is bringing new development potential and industrial opportunity to the South. It spans the Apalachicola River just below the confluence of the Flint and Chattahoochee Rivers, and provides a new lake and recreation area, a new waterway, and 30,000 kilowatts of new power.

Contractors for this highly useful project were Perini, Walsh, Mills, and Blythe Brothers construction companies, a joint venture sponsored by B. Perini and Sons, Framingham, Massachusetts.

All the cement for this job was manufactured at Ideal's strategically located plant at Mobile, Alabama. Ideal's ability to deliver cement continuously from the big production of the Mobile plant guaranteed maintenance of construction schedules even through periods of the most critical cement shortage.

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. . . . . Am-Soc Briefs

▶ ▶ Civil engineers are sharing in today's higher salaries. With returns from the Society's fourth biennial salary survey tabulated, the news is that salaries have shown a marked increase since the 1955 survey. Unlike previous years, the upward trend — originally felt only at recent-graduate levels — is now showing up throughout the entire salary scale. The 1957 report of the Committee on Salaries is abstracted in Society News. . . . Even the Society's quarterly Engineering Salary Index (page 84), based on consulting and highway department salaries, shows a rise in the past quarter. Beginning with this issue, the Index will be published every month as a handy reference.

▶ ▶ Are you dissatisfied with ASCE membership designations? Now is the time to speak up. The ASCE Task Committee on Classification of Members has drafted a proposal for changes in designation, which was presented to the Board at its Buffalo meeting. At the instruction of the Board, the report is printed in this issue (page 81) for review and comment of the membership. If you have ideas or suggestions on the subject, make them known at once through your Local Section. The Sections must forward all comments to the Executive Secretary before October 1.

▶ ▶ Buffalo Convention echoes. . . . Thanks to the Buffalo Section, it was a fine meeting with every hour profitably and pleasantly accounted for. . . . The Board of Direction commended the Buffalo Section; nominated Louis Howson, Chicago sanitary engineer and former ASCE officer, for next year's President; selected four new Honorary Members; and gave the nod to Prize Committee choices for fourteen coveted Society awards. . . . Honorary Members and prize winners are listed in Society News, and there will be biographies and photos later.

▶ ▶ On the theory that members will want to know what is going on in the Technical Divisions outside the two in which they are registered, "Civil Engineering" has a new department, "Division Doings" (page 83). Especially timely in this month's quick rundown is the Highway Division's endorsement of BPR design standards. . . . Incidentally, Technical Division enrollment is increasing by leaps and bounds, with 15,423 new enrollments added during the year ending June 1.

▶ ▶ "It is entirely proper for the Society as a whole, for Local Sections, or individual members to engage in a dignified and orderly program of invitations for prospective members." This quotation from the Society's Rules of Policy and Procedure continues to be sound. . . . In case you need membership application forms, they are available from your Local Section officers or the Executive Secretary.

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do you know that

This working season will see the bulk of the concrete in place for the billion-dollar St. Lawrence Seaway and Power Project? Comparisons of the varied methods in use for forming, hauling, and placing the 6,000,000 cu yd of concrete required on the major St. Lawrence projects make up an engrossing article (page 40), one of several in this issue that round up construction progress to date.

• • •

Outmoded equipment has no business in the modern construction picture? While the average engineer does not normally come to grips with a billion-dollar project, he will find every job easier with up-to-the minute tools. The last word in construction equipment is yours for the looking in the advertising and "New Equipment and Materials" departments of each issue.

• • •

Buildings can be made tornado-proof at slight extra cost? This is the opinion of George W. Reynolds, research associate in the Engineering Research Institute at the University of Michigan, who has been studying tornadoes since 1949. His findings—presented at a recent meeting of the American Meteorological Society—indicate that most structures destroyed suffered from one or more major shortcomings: Improper anchorage, insufficient internal bracing, or lack of proper air vents. Attention to these three details, he believes, might eliminate "as much as 90 percent of tornado deaths and injuries." The increase in cost is estimated at from $50 to $350 per structure.

• • •

Freezing desalts sea water? "Frozen sea water has an instability that may be advantageous to man," according to the Ohio State University Research Foundation. Ice so formed, it reports, may "when it is old, be fresh enough to melt down for drinking water." Other techniques for reclaiming sea water are reported in the account of the AWWA's 7th annual conference (page 91). Incidentally, an International Symposium on Saline Water Conversion is planned for early November in Washington, D. C. (page 92).

• • •

The construction picture is spotty? In Chicago the trend is up, with a three-year $207,000,000 program of public improvements on the agenda. Belated housing booms are responsible for a sharp rise in construction in San Diego and Washington, D. C. Industrial building is bolstering construction in Seattle and Los Angeles. In New York City, on the other hand, the boom shows definite signs of slowing as the result of a sharp decline in office building. On a regional basis, the outlook is said to be best in the South Atlantic region and worst in the Rocky Mountain and East South Central areas.

Downtown San Francisco suffered relatively little structural damage in the earthquake of March 1957? However, extensive damage to glass, stucco, plaster, and foundations was reported from residential areas adjacent to the fault. These official Building Department findings, which point up the importance of earthquake-resistant construction, are revealed in a study of the behavior of structures in earthquakes by Prof. George W. Housner, A.M. ASCE, of California Institute of Technology—prepared for the Kaiser Steel Corporation and released as the May issue of its publication, "Modern Designing with Steel."

• • •

The 1,200-mile Great Lakes waterway is the busiest in the world? In the eight-month navigation season of 1955 total cargo carried exceeded 239,000,000 tons. During the entire twelve months of the same year, the Panama and Suez canals combined carried only 162,000,000 tons. Source of these figures is the Detroit District of the Corps of Engineers, which has begun a five-year channel improvement program.

• • •

It may be possible to keep strategic waterways open to navigation in the coldest weather? Compressed air is the solution to ice-clogged ports, according to Atlas Copco, international manufacturer of pneumatic equipment. Use of a compressor to pump air through pipelines running well below the surface of the water is reported in successful use in Sweden, and the method was tried out at the Slave Falls Dam, Winnipeg, this past winter. Air bubbles released from the pipes at 50-ft intervals stream toward the surface carrying warmer water, which melts the surface ice.

• • •

Surveying parties are asked to refrain from driving nails into trees? The plea comes from the Society of American Foresters and from Thomas F. Luther, owner and operator of a large planted forest at Saratoga Springs, N. Y. Nails driven into trees by surveying and engineering crews, they warn, have not only resulted in extensive damage to power hand saws and saws in mills but have caused serious accidents.

• • •

Two unusual examples of prestressing steel structures will be described in the August issue? One, a British project, is an 80-year-old through-truss railroad bridge that has been rehabilitated and strengthened by attaching and prestressing four high-strength Stressteel Macalloy bars to each bottom chord of the two trusses. The other is the wind bracing in the structural frame of the new 21-story Conrad Hilton hotel, the Queen Elizabeth, in Montreal.

Precast 'Incor' School

SAVES MONEY, TIME...LIVES

● School Boards and Taxpayers everywhere are wrestling with the problem of providing badly needed schools in a hurry, while keeping costs within manageable limits. This unusually attractive Hoosier school points the way to a sound solution—that is, the precast concrete school.

Structural frame and roof were precast at job site. Careful planning, with standardization and repetition uppermost in mind, made possible utmost re-use of forms in the casting beds . . . dependable 'Incor' high early strength produced maximum output with minimum form investment.

Result, this 36-classroom, 1200-pupil, one-story building, with three classroom units radiating from central administration, service and cafeteria unit—at a cost of $858,000. Contributing to this economical end result was a saving of $16,000, realized through the use of precast frame and roof, as against conventional methods.

To initial economy, add concrete's incomparable advantages of lowest annual cost, plus the all-important assurance of utmost fire-safety, and you have the answer to the problems of a school board or anyone else looking for a way to squeeze the utmost out of today's building dollar.

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Structural Engineer: **FLOYD E. BURROUGHS,** Indianapolis

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NEEDED — *engineers in public office*

GEORGE D. CLYDE, M. ASCE, Governor of Utah

After spending the major part of my adult life in the profession of engineering, suddenly, and rather unexpectedly, I entered the field of politics. Considering the accomplishments of ASCE as a body, and the contributions of its individual members, I feel very humble in offering a word of advice to such a group. But I believe this advice is of value, and will increase the engineer's already great contributions to society.

Despite the example of Herbert Hoover, engineers are still considered a rarity in politics, and for this they have only themselves to blame. Comparatively few engineers take an active part in public affairs, yet there is surely no valid reason why an engineer is less suited to public life than a business man, an educator, or a member of any other accepted profession. In fact, there are excellent reasons why the training and disciplined thinking of engineers are needed in the complex world of today, and there are particular reasons why engineers owe a special debt of public service to the society in which they live.

When the first A-bomb shook the ground and lighted the pre-dawn skies at Alamagordo, a new and frightening era began in the world. In the years since, the dizzy pace of scientific and material progress has been maintained, perhaps even accelerated. The world has been shrunk to a fraction of its former size by the speed of modern transportation and communication. There is no longer such a thing as safe isolation. Engineers continue to surpass their old records with a casualness that is disconcerting. We talk easily of the new multi-billion-dollar superhighway program with the sure knowledge that building it will be a comparatively simple matter.

These accomplishments are deeply impressive, but the disturbing thing is that progress in social and human relationships has not kept pace. I sometimes wonder if we, as a nation, are not in the position of a child left surrounded by an immense stack of expensive Christmas gifts while his parents go off to a cocktail party. We could do with fewer material things and more spiritual understanding.

The brains that have created the world of technology and material wealth—the men of science, the engineers, the leaders of business and industry—should turn at least a part of their powers to our social and spiritual problems and to the conduct of our government.

I see a particular need for the engineer to participate more fully in government. The application of engineering principles to its complex problems could be salutary in the extreme. I sincerely urge you to take an active part in civic affairs, even to seek and hold public office—although I make apologies in saying this, for there have been days when I thought longingly of the simplicity of a difficult engineering problem.

But government has grown into an incredibly huge and complex operation. Even the most blasé bureaucrats were startled to learn recently that our federal payroll—exclusive of the military—now exceeds a billion dollars a month. We all complain about this sort of thing—about high taxes and about our foreign policy—and then sit back and leave it up to the "professional politicians," whoever and whatever they may be.

As engineers, we know that if we want something done right, we had better do it ourselves—or at least supervise the operation to make sure the required standards are met. There is a great deal that needs doing in government right now. Here are just a few of the areas where engineers have special qualifications:

Transportation and communication—an obvious role

Public health, particularly sanitation and water supply

Conservation and efficient use of our natural resources

Education, particularly in selecting curricula and providing proper facilities

Military affairs, in planning and developing machines of war and in setting up and keeping up to date an adequate system of logistics

Government finances—and if the role of the engineer in this whole area is not immediately obvious, just consider the difference it would have made in our present fiscal picture if those in charge over the years had applied to all sizeable government projects the engineer's basic criterion that "The benefits must exceed the cost."

Now it is realized that in most of these areas many engineers are employed by the various departments of government—local, state, and national. But there is a tremendous difference between working at a staff level and working at a policy-making level, where broad, overall programs are originated.

There is need, urgent need, for the background, experience, and peculiar quality of thinking of the engineer at this higher level. I sincerely hope it will not be long before it will cease to be unusual to find an engineer in public office.

(This article has been prepared from an address by Governor Clyde before ASCE's San Francisco Section.)

ST. LAWRENCE PROJECT--

planning and construction progress

Well-coordinated progress is being made on most phases of the billion-dollar St. Lawrence Seaway and Power Project. Navigation will be shifted to new channels in July 1958, in coordination with the raising of the power pool. First electricity will go on the line shortly after the head pond is raised, the total generated power reaching 2,200,000 hp in September 1959. And navigation will have a 27-ft channel to Lake Erie at the start of the 1959 season. The deepened channel to ports on the upper Great Lakes is scheduled for completion in 1962.

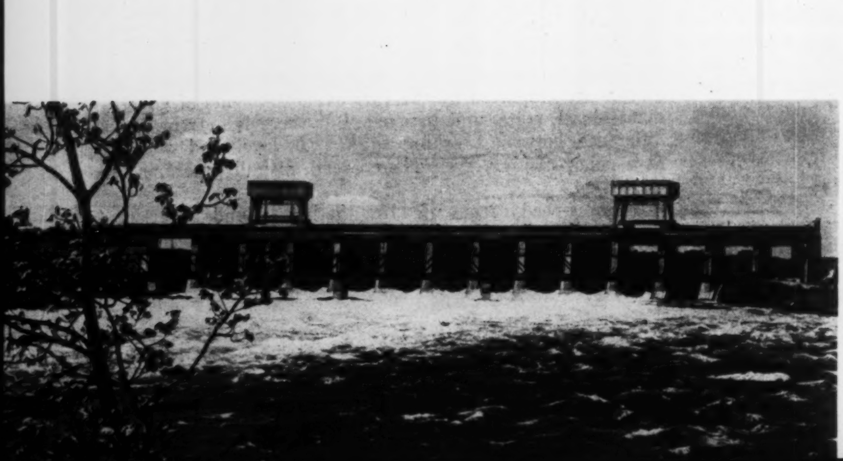
From the sea to Montreal, drafts of 32 ft or more are now available. On the Great Lakes and the St. Lawrence River as far downstream as Ogdensburg, N. Y., and Prescott, Ont., channel depths are 18 ft for upbound traffic and 21 ft for downbound. (Authorized depths are 21 and 25 ft respectively.) The intervening 119-mile "bottleneck" between Ogdensburg and Montreal is restricted by the dimensions of the 22 canal locks in the reach, which are 252 ft long, 44 ft wide and 14 ft over the sills.

On the St. Lawrence River canal system, bulk carriers now average only about 2,500 to 3,000 tons in capacity and general cargo vessels about 1,500 tons. By contrast, many vessels on the Great Lakes carry 20,000 short tons of bulk cargo, some over 25,000 tons. Total annual volume of shipping on the Lakes and River approximate 300,000,000 tons in the 8-month navigation season. Less than 1 percent of this is in foreign trade, which must use the St. Lawrence canals. The remainder of the 12,000,000 annual tonnage on the St. Lawrence, which is very near the present capacity of the system, can be termed "coastwise" shipping. It is largely pulp wood, coal and petroleum products moving between ports on the Lakes and the River. Iron ore from the recently developed Labrador deposits is already swelling the volume of this coastwise traffic.

Power is now developed at the fall of about 295 ft in the Niagara area and at the 80-ft fall in the Soulanges section, a short distance above Montreal. The Aluminum Co. of America develops about 70,000 kw at Massena, N. Y.

Agencies participating

The agencies responsible for constructing, operating and maintaining the navigation works in Canada and the United States are respectively the St. Lawrence Seaway Authority and the St. Lawrence Seaway Development Corporation. Their powers and functions are essentially the same. The Seaway Authority (Canadian) is carrying out design and supervision of



Entire flow of St. Lawrence is now diverted through Stage 1 of Long Sault Dam, here seen from Barnhart Island.

Lawrence H. Burpee, A. M. ASCE
Deputy Chief Engineer, St. Lawrence Seaway Authority,
Montreal, Que.

A. F. Griffin, M. ASCE
Special Engineering Consultant,
North Central District, Corps of Engineers, Chicago, Ill.

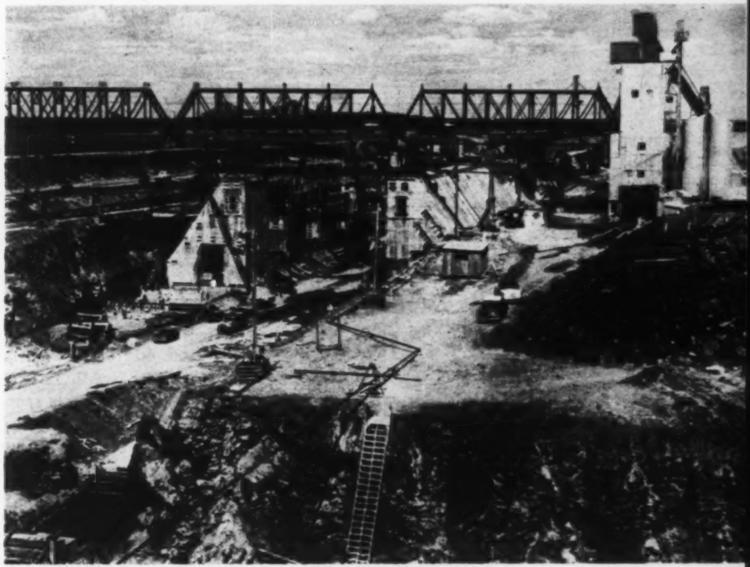
L. W. Angell, M. ASCE
Assistant Chief Engineer, Saint Lawrence Seaway
Development Corporation, Massena, N. Y.

Barnhart Power Dam at lower end of International Rapids will have 32 turbines each rated at 85,000 hp at 85-ft head. International boundary runs through center of dam. United States side is in foreground.

construction with its own forces. The Seaway Corporation (U. S.) utilizes the Corps of Engineers, U. S. Army, as design and construction agent.

The Hydro-Electric Power Commission of Ontario (HEPCO) and the Power Authority of the State of New York (PASNY) are building and sharing the cost of the power development in the International Rapids Section. The Canadian authority, HEPCO, is carrying out all design, engineering and supervision of construction with its own staff. For PASNY, the engineering firm of Uhl, Hall & Rich of Boston are handling engineering and supervision of construction.

Power in the lower part of the St. Lawrence is entirely within the province of Quebec, and is under the control of the Quebec Hydro-electric Commission (Quebec-Hydro). Almost all construction on the entire St. Lawrence is being done by contracts



St. Lambert Lock, now under construction, is so placed that historic Victoria Bridge crosses lower gate area. Additional bridge is being built just upstream so that highway traffic can be channeled to either crossing as navigation permits.

Iroquois Lock, in foreground, will be filled and emptied by sector gates at each end. It is Canadian built. Dam to right above, in United States, has maximum head of only 6 ft but will regulate flow of more than 300,000 cfs to maintain level of Lake Ontario.

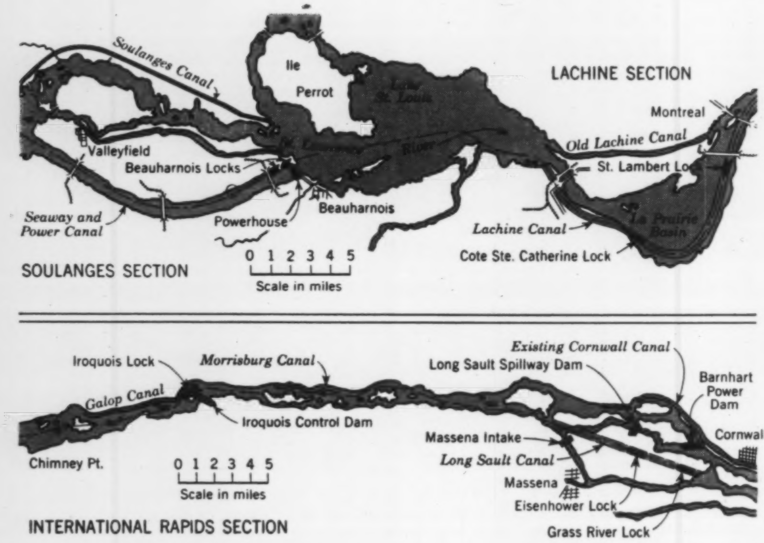

Soulanges Canal
Ile
Perrot
Lake St. Louis
LACHINE SECTION
Montreal
Old Lachine Canal
St. Lambert Lock
Valleyfield
Beauharnois Locks
St. Lawrence River
Seaway and Power Canal
Powerhouse
Beauharnois
Lachine Canal
La Prairie Basin
Cote Ste. Catherine Lock
SOULANGES SECTION
0 1 2 3 4 5
Scale in miles
Existing Cornwall Canal
Iroquois Lock
Morrisburg Canal
Long Sault Spillway Dam
Barnhart Power Dam
Galop Canal
Iroquois Control Dam
Massena Intake
Cornwall
Chimney Pt.
0 1 2 3 4 5
Scale in miles
Long Sault Canal
Massena
Eisenhower Lock
INTERNATIONAL RAPIDS SECTION
Grass River Lock

FIG. 1. More than a billion dollars is being spent on lower 120-mile reach of St. Lawrence for navigation and power.

awarded under the competitive-bid system.

Completion schedules and cost

Raising the power pool in the International Rapids section is scheduled for July 1, 1958, at which time the Seaway works must be ready to accommodate the shipping now using Canadian 14-ft canals. The works downstream from the head of Lake St. Francis to Montreal are to be completed for the opening of navigation in the spring of 1959, at which time the Welland Canal will have been deepened to 27 ft.

Estimated cost of the Canadian Seaway works on the St. Lawrence is $260,000,000; deepening of the Welland Canal will add another $25,000,000. The U. S. Seaway works are expected to cost about $140,000,000. Power costs in the International Rapids section, including some navigation improvements, are to be borne equally by the two power authorities and are estimated at $600,000,000.

All-Canadian section

The 75-mile reach of the river from Montreal to Cornwall has three distinct parts—the Lachine, Soulanges and Lake St. Francis sections. (See maps, Fig. 1.) The Lachine section extends 30 miles from deep water in Montreal harbor to the upper end of Lake St. Louis. Seaway plans here have been coordinated with future plans for the development of 1,000,000 hp by Quebec-Hydro from a head of about 50 ft.

First obstruction on the Seaway is the Jacques Cartier Bridge, a four-lane structure carrying over 50,000 vehicles a day between Montreal Island and the south shore. To provide 120 ft of underclearance, the bridge will be raised 40 ft this summer, and an additional 40 ft will be gained by substitution of a through truss for a deck truss at the channel.

St. Lambert Lock, first on the Seaway, is located immediately upstream from Victoria Bridge at the city of St. Lambert and has a lift varying from 2 to 20 ft, depending on the water level in Montreal Harbor.

Victoria Bridge in Montreal carries the double-track main line of the Canadian National Railways from Montreal to the south and also has two 16-ft highways. As many as 120 trains a day cross the bridge, and highway traffic exceeds 25,000 vehicles. The bridge will have a lift span for railway and highway traffic. Construction of a second lift span across the upper end of the lock will enable highway traffic always to move across the Seaway, either on Victoria Bridge at the lower end of the lock or across the new span. The new span is designed to accommodate a future double-track railway.

Excavation of a channel and construction of a dike is required in the nine miles to Cote Ste. Catherine Lock, which will have a lift varying from 30 to 40 ft. The channel above the lock is being constructed to a bottom width of 250 ft with provision for hydraulic control works suitable for bypassing 40,000 cfs during the non-navigation season.

A high-level approach for the Honoré Mercier highway bridge will maintain uninterrupted traffic on this important highway route. A lift span is being added to the Canadian Pacific Railway crossing in this area.

Soulanges-Beauharnois section

Water rights in the Soulanges section of the St. Lawrence were granted to the Beauharnois Light, Heat and Power Company, now part of the power system of the Quebec Hydro-Electric Commission. The power development began operation in 1932 with an installation of 250,000 hp. The plant has been progressively enlarged to its present capacity of 1,400,000 hp, to which 600,000 hp is now being added.

A 600-ft space along the north side of the 15-mile-long power canal at Beauharnois has been left for the navigation channel. Work is now under way on two locks to provide the lift from Lake St. Louis to Lake St. Francis.

For construction, a cofferdam has been built to the point in Lake St. Louis where the depth of channel cut is 7 ft, beyond which it is more economical to dredge. The lower Beauharnois Lock is in a 40-ft rock cut excavated in sandstone. The durable and dense nature of the rock permits extensive use of rock anchorages to eliminate the necessity for full gravity structures for the approach walls. The existing highway along Lake St. Louis is being carried under the Seaway by a dual highway tunnel just uptsream from the lower lock.

The upper Beauharnois Lock, 4,000 ft upstream, is quite similar to the lower lock with the exception that it will have a single pair of miter gates downstream and a pair of sector gates for emergency use at the upper end, in addition to a single pair of standard miter gates. The New York Central Railroad will cross the upper end of the upper lock on a swing span, which will also provide a service road.

Above the locks, navigation will use the 15-mile power canal, already at 27-ft depth for most of its length. Two combined railway and highway vertical-lift spans are required to open the power canal for navigation use. Piers for these bridges were constructed at the time of the power development. Present work is only to replace the existing fixed 200-ft spans with lift spans.

International Rapids section

Key structure in the development of power in the International Rapids section is the generating station across the North Channel of the St. Lawrence at the foot of Barnhart Island. A huge cellular sheetpile cofferdam closes the downstream side of the powerhouse; the upstream side is protected by Barnhart Island and a construction cofferdam across a narrow area of the channel.

The St. Lawrence Power Dam is a structure 3,300 ft long resting on dolomite interbedded with thin strata of shale, sandstone, limestone and gypsum. Some grouting is required to seal underground channels but the foundation is quite adequate. About 2,440,000 cu yd of concrete is required for the structure, which will have a maximum height of 167 ft.

The power plant will have an installed capacity of 2,200,000 hp, second in size in the world only to that at Grand Coulee Dam. The International Boundary divides the plant in half. Sixteen of its 32 generating units are being constructed and will be operated by the Power Authority of the State of New York; the other 16 are being installed and will be operated by the Hydro-electric Power Commission of Ontario. The power units are similar for the entire plant, a semi-outdoor type, with removable individual covers over the generators. At each end and at the center of the powerhouse are sluices for passing ice.

Work is all in one cofferdam with the International Boundary just an imaginary line. But U. S. contractors have the work on the U. S. half, and Canadians are handling the work in that country. In general, Canadian work has been concentrated in larger pours, moving slowly out from the shore. The U. S. policy has been to spread out across its half of the powerhouse, building in low lifts and completing all the foundation work as rapidly as practical. Quantities are almost identical on the two halves of the work, and there is competition to get the most done.

Canadian contractors were ahead of the U. S. side when warmer weather permitted resumption of full construction this spring. The Canadians had worked through the winter using higher vertical lifts, which were much easier to protect from temperatures that went to 44 deg F below zero. With a larger concreting plant, it is expected that the U. S. crews will be ahead of the Canadians when cold weather arrives this fall, but both sides are ex-

CONSTRUCTION CONTRACTS OVER $3,000,000, ST. LAWRENCE SEAWAY AND POWER PROJECT

International Rapids Section

Projects	Contract Amount	% Complete June, 1, '57	Usable Completion Expected
Barnhart Island Power Dam:			
Canada: Power Dam, Iroquois Contractors, Ltd.†	$29,000,000	52	Sept. '60
Dike and bypass canal, C. A. Pitts Ltd.	3,044,000	77	Nov. '57
Cornwall Dike, Atlas Constr. Co. Ltd.	3,334,250	54	Nov. '57
U. S.: Power Dam, Perini* sponsor	37,117,926	63	Dec. '59
Aggregates, Tecon Corp.	6,012,929	65	Dec. '59
Long Sault Dam:			
U. S.: Walsh* sponsor	27,342,092	70	Dec. '58
Massena Intake:			
U. S.: Morrison-Knudsen* sponsor	8,900,581	87	Dec. '57
Iroquois Lock and Dam:			
Canada: Lock, Iroquois Constructors Ltd.†	6,470,000	90	Dec. '57
Dredging lock approaches, Canadian Dredge & Dock Co.	3,245,450	10	Dec. '58
U. S.: Dam. Kiewit, Johnson & Johnson	15,719,349	82	Feb. '58
Long Sault Canal and approaches (all U. S.):			
Grass River Lock, Perini* sponsor	26,751,828	55	Jan. '58
Eisenhower Lock, Morrison-Knudsen* sponsor	20,172,451	55	Jan. '58
Canal (dry excav.), Kiewit & Morrison-Knudsen	6,400,022	60	May '58
Grass River approach, Great Lakes D. & D.	3,483,075	Started	June '58
High-Level Bridge, South Cornwall Channel:			
Canada: Substructure	1,240,550	40	Aug. '57
U. S.: Superstructure, U.S. Steel Corp.	4,764,403	Started	Nov. '58
Channel Improvements:			
Canada: Galop Island, C. A. Pitts Ltd.	11,700,420	78	July '58
Cardinal, Canadian D. & D.	6,355,250	0.5	Dec. '59
Iroquois Point, Iroquois Constructors Ltd.†	8,367,000	42	July '58
Three Points, Atlas Constr. Co. Ltd.	3,532,150	10	Nov. '58
Morrisburg, Canadian D. & D.	3,529,975	0	Dec. '59
Chimney Island, Canadian D. & D.	4,374,020	51	July '58
Cornwall Is., excavating So. Channel, C. A. Pitts	4,044,270	10	Nov. '58
Cornwall Is., dredging and improvements, Marine Industries Ltd.	13,411,000	10	Dec. '58
Cornwall Is., dredging No. Channel, McNamara Constr. Co.	3,574,000	10	Nov. '58
U. S.: South Galop, Morrison-Knudsen	6,888,980	97	Aug. '57
Sparrowhawk, Merritt-Chapman & Scott	9,794,810	56	Dec. '58
Chimney Island, Great Lakes D. & D.	....	100	......
Three Points, Kiewit and Morrison-Knudsen	12,407,705	47	Aug. '58
Thousand Islands, Tecon Corp.	4,748,387	30	Feb. '58

All-Canadian Sections of Seaway

Projects	Contract Amount	% Complete June, 1, '57	Usable Completion Expected
Lachine Section:			
Dredging, approach to Montreal Harbor, Marine Industries	10,636,000	30	Sept. '58
Modification to Jacques Cartier Bridge, Dominion Bridge Co.	6,960,445	20	Nov. '58
Channel and dike, Sta. 124 + 00 to 200 + 00, McNamara, Pigott, Peacock and McQuigge	3,758,675	95	July '57
St. Lambert Lock and approaches, McNamara, Pigott, Peacock and McQuigge	7,644,997	40	Sept. '58
Superstructure for two vertical-lift bridges over St. Lambert Lock, Dominion Bridge Co.	6,061,640	..	Apr. '59
Channel and dike, Sta. 250+00 to 450+00, Walsh Canadian Constr. Co.	5,031,139	75	Dec. '57
Channel and dike, Sta. 450+00 to 605+00, Northern Constr. and J. W. Stewart	3,282,321	60	Sept. '58
Cote Ste. Catherine Lock and approaches, Canamont and Canit	7,452,633	50	Aug. '58
Channel and dike Sta. 752+00 to 900+00, Northern Constr. and J. W. Stewart	4,927,700	50	Sept. '58
Channel and dike, Sta. 900+00 to 930+00; embankments and C.P.R. bridge substructure, Atlas-Winston Ltd.	3,327,725	30	Sept. '58
Honoré Mercier Bridge, superstructure, Dominion Bridge Co.	7,376,999	..	June '58
Vertical-lift bridges for C.P.R. at Caughnawaga, superstructure, Dominion Bridge Co.	3,078,731	..	June '58
Channel and dike, Sta. 930+00 to 1045+00, Miron and Mannibec	5,843,750	75	Sept. '58
Dredging Lake St. Louis, Marine Industries Ltd.	8,219,000	70	Oct. '58
Soulanges Section:			
Beauharnois Locks, first-stage excavation for Atlas-Winston Ltd.	3,504,999	100	....
Lower Beauharnois Lock, Canit Constr.	11,284,970	35	Nov. '58
Upper Beauharnois Lock, United Waterways	14,479,319	25	Dec. '58
Vertical-lift spans at St. Louis and Valleyfield Bridges, Dominion Structural Steel	6,343,146	..	Mar. '59
Lake St. Francis Section:			
Dredging, Lake St. Francis, Fraser Point to Cornwall, Canadian D. & D.	4,698,000	75	July '58
Welland Canal Section:			
Dredging guard gate to Sta. 710+00, Russell Constr. Co.	7,280,575	10	Oct. '58
Dredging, Sta. 1231+00 to 1460+00, Canadian D. & D. and McNamara	11,623,200	25	Oct. '58

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*Joint venture of B. Perini & Sons, Inc., Walsh Construction Co., Peter Kiewit Sons' Co., Morrison-Knudsen Co., Inc., and Utah Construction Co.

†Joint venture of Canadian Comstock Co. Ltd., The Foundation Co. of Canada Ltd., Pentagon Construction Co. Ltd., Angus Robertson Limited, and Rayner & Armstrong Limited.

pected to be ready for removal of the protecting cofferdam early next spring.

Power at 13,800 v is developed by 32 generators of 60,000 kva, each driven by 75,000-hp turbines rotating at 95 rpm at an effective head of 81 ft. Output from a group of four generators goes to a nearby bank of transformers where it is stepped up to 115,000 v for nearby use or to 230,000 v for transfer to distant points.

Water for power comes from a drainage area of 300,000 sq miles, which includes the 95,000-sq mile surface area of the five Great Lakes. Annual rainfall over the area averages 31.2 in., about one third of which runs off to the river. Average annual flow is 236,000 cfs, exceeded by only a few rivers on the North American continent. Flow in the St. Lawrence is quite constant; the maximum on record is only a little more than twice the minimum. By contrast the Columbia has a ratio of 35:1 and the Mississippi 25:1.

The project has little storage at the powerhouse but can take limited advantage of Lake Ontario for flow variation. Control of flow to and diversion from the power dam is effected by Long Sault Dam. This concrete gravity, curved-axis spillway structure extends 2,960 ft across the main and south channels of the St. Lawrence just below the spectacular Long Sault Rapids. The spillway is equipped with thirty 52 x 30-ft vertical-lift gates, designed for close control of the river as well as passage of the maximum flow. A total of 700,000 cu yd of concrete is required in structures that have a maximum height of 114 ft.

Construction and river diversion at Long Sault were complicated by the necessity for maintaining near constant depth in navigation channels in the area. Sheetpile cofferdams protected construction of half the structure last summer. During early spring, rock dumped across the swiftly flowing channel diverted the river through the new construction. An earth blanket on the rock fill, and an earth cofferdam downstream made it possible to open up a large area for completion of the dam, now under way.

About 10 percent of the flow of the St. Lawrence now goes through a hydro plant of the Aluminum Company of America at Massena and discharges into the Grass River. To control flow to this plant and for domestic and industrial needs at Massena, an intake is being built. This gravity structure contains 191,000 cu yd of concrete and will have fixed-roller gates for flow control. The 710-ft-long structure is being built in two stages in circular sheetpile cofferdams as it is necessary to go more than 100 ft below the power-pool elevation to reach bedrock. When the Barnhart Power Dam is in full operation, the Aluminum Company's plant will be abandoned for power purposes.

Some 30 miles upstream, a flow-regulation structure is being built—the Iroquois Control Dam near Iroquois, Ont. This will provide control of Lake Ontario levels and assist in controlling the speed of flow to form an ice cover in winter. This structure, 2,335 ft long, is on rock with most of its length a gated spillway with sills near river-bed elevation. Its thirty-two 52 by 48-ft vertical-lift gates will be handled by overhead gantries. In operation the head differential will rarely exceed 5 ft.

Iroquois Dam is being built in two stages. Part of the U. S. side was constructed in a land area with earth dikes extending out into the stream. In October 1956, water was turned through the open gates of the first stage and a steel sheetpile cellular cofferdam started across the rest of the river. By dumping rock ahead of the construction, relatively quiet water was created for setting the sheetpile cells on the clean-swept bottom. About 30 cells were set, and the cofferdam was pumped out so that work could proceed early in January 1957.

Raising the St. Lawrence to the power-pool elevation requires an extensive dike system. On the U. S. side, suitable materials for dike construction are available close at hand from the canal excavation. On the Canadian side, the dike system is necessary only near the power plant, except for a few short saddle dikes upstream.

Navigation at International Rapids

An estimated 55,000,000 cu yd of dredging is necessary over a 17-mile stretch from Chimney Point to Morrisburg, Ont. Dredging will be so located as to provide for navigation, maintain current velocity within a safe limit for shipping, reduce the head loss, and in some areas, lower the velocity of flow to a value that will permit ice cover to form and thus reduce the danger of frazil ice.

Creation of the power pool requires extensive relocation, including the towns of Iroquois and Morrisburg on the Canadian side. About 40 miles of main-line railway and 35 miles of through highways are being rerouted, with power and utility lines. On the U. S. side fewer relocations are required; in general traffic will be shifted to highways outside the pool area.

In the Barnhart Island area, navigation during construction is being maintained through the existing 14-ft canal on the Canadian side. It has been necessary to construct a bypass canal with concrete headworks, which can be used for navigation while an earth embankment is being constructed across the existing canal to connect with the power dam. Stop-logs can be dropped into the concrete headworks when raising the water level to the permanent pool elevation. This work is completed, and ships are using the new temporary channel.

The navigation channel around the Barnhart Power Dam will be on the U. S. side. The Long Sault Canal, 10 miles long, is being constructed in the dry through open farming country, except for dredging at the lower approach to the Grass River Lock. Excavation totaling about 33,500,000 cu yd is being done under five contracts. The canal is 442 ft wide at the bottom, and side slopes are generally 2 on 1, but in some areas the soil requires flatter slopes for stability.

The upstream two-thirds of the canal is largely in glacial till, an extremely heavy material (150 lb per cu ft) interspersed with boulders. The downstream part of the canal is largely in marine clay, a material that easily becomes fluid and requires slopes as flat as 12 on 1 to prevent slides at the lower lock excavation. The two locks on the Long Sault Canal are quite similar, with controlling dimensions of 860 ft between gate pintles and 80 ft wide, with a 30-ft minimum depth over the sills.

The upper lock, dedicated in June 1956 as the Dwight D. Eisenhower Lock, has miter gates for normal operation and a vertical-lift emergency gate above the upper miter sill that can be raised against a head of flowing water in case of destruction of either service gate. Primary protection against damage from ships out of control is provided by cable fenders above and below each gate. A unique feature of the Eisenhower Lock is a vehicular tunnel through the upper sill to serve the area north of Long Sault Canal and to provide access to the new St. Lawrence State Park and the Power Dam.

Both the Eisenhower and the Grass River Lock, 3½ miles downstream, are being built in open cut. At the start of construction this spring, each job had about 40 percent of its total concrete placed. Work is progressing around the clock with expectation that concreting will be practically finished by cold weather this fall.

Nearly four miles of dike construction are included in the navigation works. Some natural low spots along the intermediate pool between the locks, where dikes would otherwise be required, are filled by spoil from the excavation. Ample glacial till is available for dike construction. Upstream slopes are generally 3 on 1, and downstream slopes $2\frac{1}{2}$ on 1, but in some locations foundation conditions require a broader base and flatter slopes. Riprap and a filter layer are provided on the pool side and a toe drain and filter on the land side where required. Maximum height of dike is about 45 ft, but the average is 25 ft.

Cornwall channels

The present international rail and highway crossing between Rooseveltown, N. Y., and Cornwall, Ont., utilizes low-level bridges across the South and North Cornwall channels. The bridge across the South Channel must be removed to make way for navigation. Recently the New York Central Railroad agreed to abandon the line from Rooseveltown to Ottawa. The two Seaway authorities are jointly constructing a high-level suspension bridge for highway use only, about 1,000 ft upsteam from the present South Channel bridge.

The main span will be 900 ft long with anchor spans of 450 ft each, and a 27-ft roadway. The Seaway Authority (Canadian) will construct the substructure and the Seaway Corporation the superstructure. Completion is not expected by the time the new channel is opened to navigation, so a ferry may be operated for a few months.

Dredging is required in both Cornwall channels for navigation. The channel south of Cornwall Island must be widened and deepened to 27 ft to reduce average velocities to about 4 ft per sec. More than 10,000,000 cu yd of material must be removed. A training dike is necessary at the Grass River Lock to direct flow from the power dam along the navigation channel rather than across the approach to the lock. Some dredging is necessary in the North Channel to maintain natural river flow.

Upstream, opposite the Iroquois Dam, the Canadians are constructing Iroquois Lock. It has the same general dimensions as the other Seaway locks but the lift will vary from a few inches to a maximum of 6 ft. The lock will be operated with sector gates at each end. Filling and emptying of the lock will be done by controlled operation of these sector gates rather than through separate gates and culverts in the lock as is conventional practice.

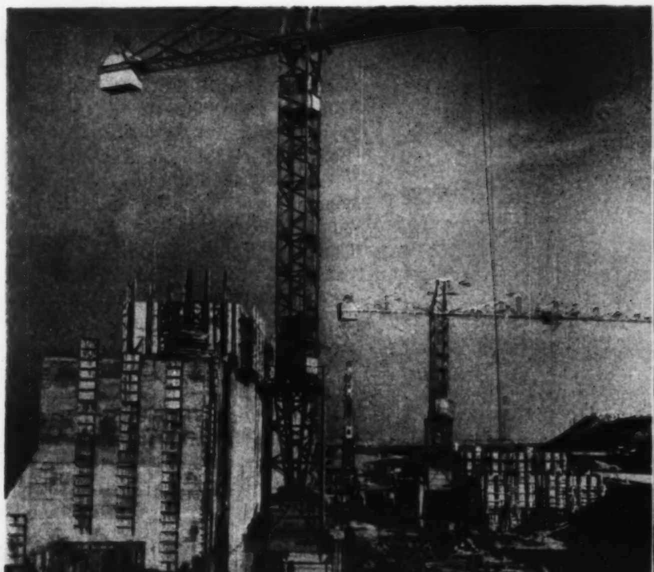
Thousand Islands to Sault Ste Marie

Upstream from the Iroquois structures, considerable dredging is under way to provide adequate navigation channels and to reduce the loss of power head. Above Ogdensburg, in the famous Thousand Islands section, the fall in a length of 64 miles is only 1 ft. Rock ledges, running generally parallel to the direction of the channel, constitute menaces rather than obstructions to navigation. As a result of Canadian and American dredging, a deep-water channel of 25 ft or more is now available through this section. Improvement, including dredging of 62 shoals, is contemplated; removal of 33 shoals is now under contract.

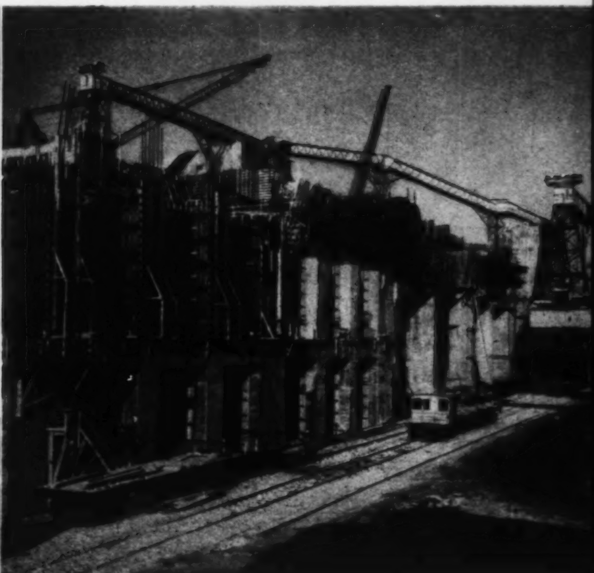
The Welland Ship Canal was completed in 1932, a series of one guard lock and seven lift locks with a total lift of 326 ft. These locks set the standard dimensions for the new Seaway facilities—860 ft in length, 80 ft in width, and 30 ft over gate sills. There has been some silting and a few bank slides, requiring 500,000 cu yd of common excavation. Work now being done includes dredging of more than 1,000,000 cu yd of rock to obtain a depth of $29\frac{1}{2}$ ft for channels in rock.

Completion of the deep waterway to all the Great Lakes is a separate part of the work, handled directly by the Corps of Engineers, U. S. Army. About 16,000,000 cu yd of hydraulic dredging and 25,000,000 cu yd of dipper dredging (including 4,000,000 cu yd of ledge rock) is contemplated, exclusive of a possible 21,000,000-cu yd hydraulic job through Indian lands in Canada. Major projects included in a $136,000,000 program are: (1) deepening of 41 miles from Lake Erie through the Detroit River; (2) deepening of 46 miles of channel in Lake St. Clair and the St. Clair River; (3) removal of shoals in the Straits of Mackinac; and (4) deepening of 63 miles of channel in the St. Mary's River, at Sault Ste. Marie.

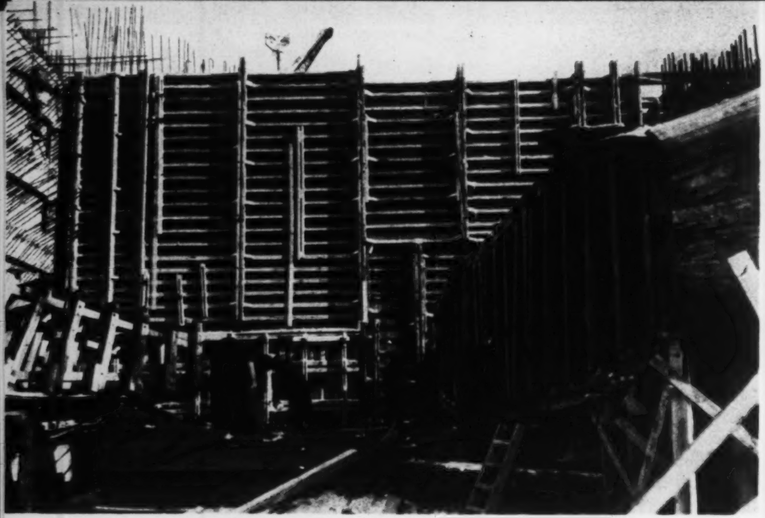
(This article is based on the paper presented by the authors at the ASCE Buffalo Convention, before a Joint Session of the Waterways and Harbors and Hydraulics Divisions presided over by Roger H. Gilman, a member of the former Division's Executive Committee. The session was sponsored by the same Division's Committee on Navigation and Flood Control Facilities.)



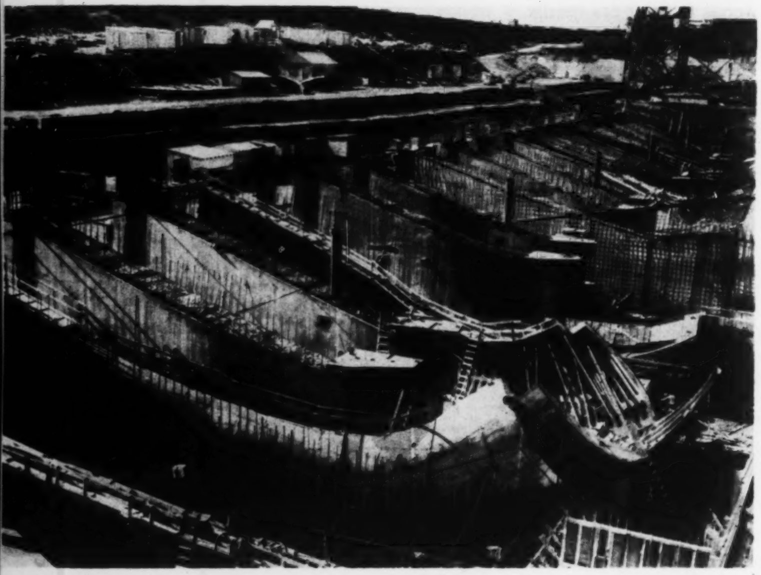
Rail-mounted cranes of European type move forms and place concrete in Cote St. Catherine Lock, in Canada near Montreal. Here ships will be lifted 30 to 40 ft.



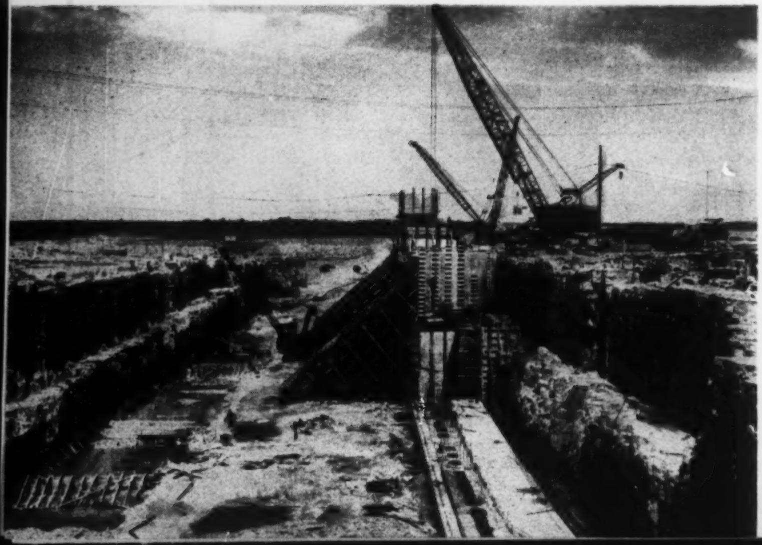
Concrete for Barnhart Power Dam, on Canadian side, moves out by conveyors, is dropped through 10-in. pipe to fill buckets moved on flat cars to cranes for placing.



Canadians use wood forms for draft tubes (above), while U.S. preference (below) is for steel forms where they can be utilized four or more times.



High-lift forms for Lower Beauharnois Lock are braced to permit easy placing of concrete against excavated rock (below).



Placing six million

HAL W. HUNT, M. ASCE,

"It's the fastest moving job since rehabilitation of the Port of Cherbourg," said Albert R. Berry, project manager on the U. S. part of the Barnhart Power Dam on the St. Lawrence River. This former Corps of Engineers Colonel was talking about all the work on the International Rapids section of the billion-dollar St. Lawrence project, not just his own part.

Work slowed through the winter when temperatures dropped to −44 deg F, but a dry spring, with a lot of work to be done, put the job on a schedule that is expected to bring completion of much of the concrete by December 15 of this year.

There is a lot of similarity, and considerable variation, in the methods used for forming, hauling, and placing of concrete on the major St. Lawrence projects. Specifications and circumstances dictated some variations, but many were the result of free choice. Comparisons keep supervisors interested in the work of others and provide valuable ideas for all constructors.

Concrete work on the United States side is being done largely by the coventurers Perini, Morrison-Knudsen, Peter Kiewit, Walsh, and Utah. These firms bid and are working in some combination on two dams, the Massena Intake, two locks, and some channel work. For each project one firm is sponsor—that having the largest percentage of investment and personnel in charge. Individual firms of this group are teamed with others on some parts of the work. For example, on the Iroquois Dam, Kiewit of Omaha is teamed with Arthur Johnson of New York and Al Johnson of Minneapolis.

On the Canadian side the principle concrete work is being done by Iroquois Constructors Ltd., made up of Canadian Comstock Co. Ltd., Foundation Company of Canada Ltd., Pentagon Construction Co. Ltd., Angus Robertson Limited, and Rayner & Armstrong Limited.

Work currently under contract or just completed in the International Falls section, a 46-mile stretch in the Massena, N. Y., and Cornwall, Ont., area, totals $750 million. Some $600

cu yd of concrete on the St. Lawrence

Executive Editor, "Civil Engineering," New York, N.Y.

million of this is for power aspects of the project and $140 million for the seaway. Canadians are spending $300 million more in the area near Montreal. A table (p. 37) shows the contractors and approximate amounts of construction contracts over $3 million.

Forms differ in type

Concrete is the big pay item on the St. Lawrence, and since forms are the key to profitable operation, a lot of thought has gone into them. On the U. S. side, height of lift has been established at 5 ft for almost all work, fixing the pattern for concrete placing. The Canadian designers have indicated lifts from 5 to 40 ft in height but high lifts usually are acceptable.

Much of the advantage the Canadians are supposed to get from high lifts is lost by three factors: (1) the building of forms in place rather than the setting of panel forms, (2) the use of tie rods that clutter the work area, and (3) the long time required to get a block ready for concreting. But there is an advantage in high lifts for winter work as it is necessary to cover the area and make preparations for heating only once rather than four to six times. And the internal heat from a large block of concrete is a help in the winter.

As the result of a symposium on variations in construction methods, sponsored by the St. Lawrence Branch of ASCE's Syracuse Section, intake-gate and similar thin sections in the U. S. Power Dam can now be placed in higher lifts. Forms for the intake gates are built 25 ft high, and concrete is placed in 10- and 15-ft increments.

On U. S. contracts, cantilever forms are used for concrete in locks and mass concrete in all other structures. The first lift off the rock may be 2½ or 3 ft high, formed with wood and generally braced or tied. Cantilever panels sometimes are turned upside down for use at the start of a block.

Cantilever forms are of wood, faced plywood and steel, with wood or steel studs and wales. On the Eisenhower Lock, an all-steel cantilever form is used, with five horizontal studs. Cantilever forms almost always are raised by a lightweight pipe A-frame with a geared or roller-chain hoist. Usually an entire side of the form is raised at one time.

The greatest contrast in forms and forming is on the Power Dam, where U.S. contractors and Canadians are at work in the same cofferdam. The Canadians (Iroquois Constructors) use wood forms exclusively. Perini, coventurer sponsor on the U. S. side, uses steel forms extensively and would use more if they had been obtainable in a shorter time.

Iroquois builds vertically in high lifts right up from the rock, moving slowly out as the shoreward blocks rise. Draft-tube forms are built for the entire unit, and most of it is concreted in one operation, which is a great help in cold weather. The Canadians placed concrete all through the winter on all areas of the Power Dam while the U. S. contractors found only very limited work economical. Wood facing has been found good for only about three uses in draft-tube forms. Where steel is used for forms bending in more than one direction, the preferred procedure is to use plywood facing rather than to warp the steel.

Perini placed the foundation blocks first as rapidly as practicable to cover the rock over the entire job. Working with four sets of steel forms, successive 5-ft lifts are concreted for the draft tubes. Excellent alignment of forms and concrete has been obtained. Above the draft tubes a single set of steel forms is used successively for all concrete, moving out from shore on a twice-a-week schedule. This requires tight scheduling but is expected to permit completion of most of the concrete by cold weather.

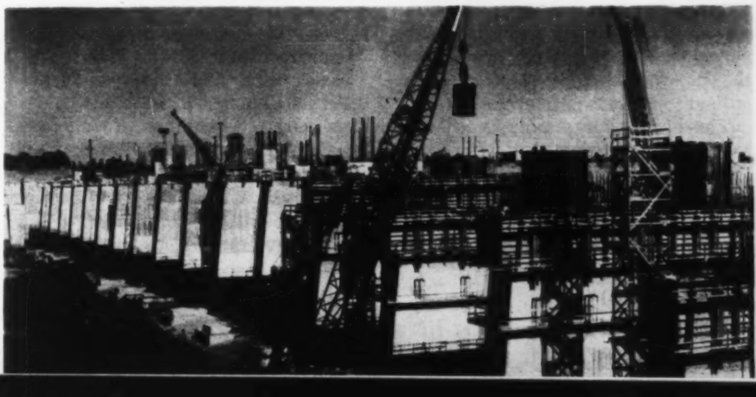
Canadian practice is to build up forms to any convenient height and then place concrete to some logical construction joint, without regard to an exact dimension. Perhaps the most unusual form is that for the Lower Beauharnois Lock. Here concrete is placed against the rock face of a deep cut, using a high frame braced by timbers extending beyond the center of the lock chamber. Thus the space usually required for concrete placing equipment is not needed. Concrete is delivered on rock at the top of the lock walls.

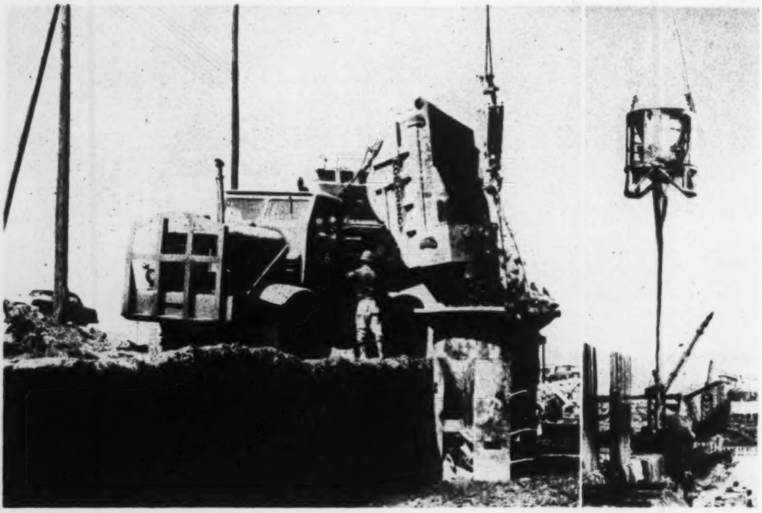
At Iroquois Lock a small traveling form is used to place a 7-ft-high base section in successive 40-ft monoliths. Above the base a large traveler on the same rails is used to place successive monoliths each 37 ft high.

Concrete from central plants

Concrete on the St. Lawrence is mixed in central plants each with two to four tilting mixers of 2- to 4-cu yd capacity. Generally concrete is fed through a collecting hopper to buckets on a truck, which transports them to the point of placement. One to three 4-cu yd buckets are hauled on a truck. Most popular is a Euclid-drawn semi-

Steel forms are used for piers of Iroquois Dam, with concrete placed by crane and bucket.





Dumptor bucket is moved to side and tilted by hydraulic system of Euclid truck to dump into special Gar-Bro bucket. To speed placing in high forms a rubber or canvas "elephant trunk" is permanently attached to some buckets.

trailer that hauls two full buckets, with space for a third so that an empty can be set down. After the second bucket is picked up the truck leaves for another load.

Saving seconds on bucket switching is a popular activity on the St. Lawrence. Some contractors use an air-powered Gar-Bro hook, which is actuated from the crane cab but guided to position by a workman. Since the hook cannot be opened while loaded, it is a safety device as well.

Perini, on the Barnhart Power Dam, has a completely different idea. Here two Koehring Dumptor bodies have been mounted sideways on a big Euclid truck and haul 4 cu yd each. At the point of placement the Dumptor is moved sideways and tipped by a hydraulic mechanism into a bucket for placing. The Dumptor moves rapidly and dumps with a thud that cleans the bucket but is a little rough on the equipment. An ingenious free-hanging pipe serves as outrigger for the truck when dumping. It is swiveled from the truck body and hangs to within a few inches above the ground on the loaded truck. When the Dumptor moves sidewise the body tips so that the pipe comes in contact with the ground to prevent overturning.

The bucket for placing is attached to the crane during the entire pour. It is a specially built 4-cu yd Gar-Bro unit dumped by air supplied from a compressor on the crane. A hose hung under the crane boom is kept taut by a Rud-O-Matic tagline system so that it cannot sag to catch on projecting steel. Dumping is actuated by a control line that hangs down from the bucket; a second line controls a pneumatic vibrator attached to the bucket to start flow of stubborn mixes.

Keeping the bucket always on the crane permits use of a rubber or canvas boot permanently attached to the bucket for placing in narrow walls and where steel is set high above the placing level. (Buckets without the boot are used for mass concrete.) The boot bends under a pipe frame when the bucket is set down for filling but hangs straight and flat for easy lowering into tight places. Use of the boot reduces time for spotting the bucket and lowering through protruding steel; it eliminates elephant-trunk spouts in the forms and prevents segregation.

Perini's project manager, Al Berry, feels he saves considerable time by this arrangement but for another job would develop a different means of transfer to the placing bucket to reduce maintenance on the Dumptor and truck.

On the Canadian side, concrete is carried on as many as four flights of 36-in. belts, then dropped vertically 150 ft through a 10-in.-dia pipe to a hopper. A cushion of concrete is maintained in the hopper to control wear. Concrete is fed into 4-cu yd buckets on a flat car, which has space for three or four buckets.

Gantry cranes place concrete on the Power Dam. Four Washington's work on the U.S. side and four American Revolvers serve the Canadians. Grass River Lock utilizes two rejuvenated Washington cranes. Eisenhower Lock has big Manitowoc cranes plus two stiff-leg derricks at the complicated upper gate sill, where a road goes under the channel.

At Iroquois Dam, cranes handle forms and concrete. They were utilized, of course, for constructing and shifting the cofferdam. Iroquois Lock uses one gantry and a crawler crane with a stiff-leg derrick at the sills for extra form work and erection of the sector gates.

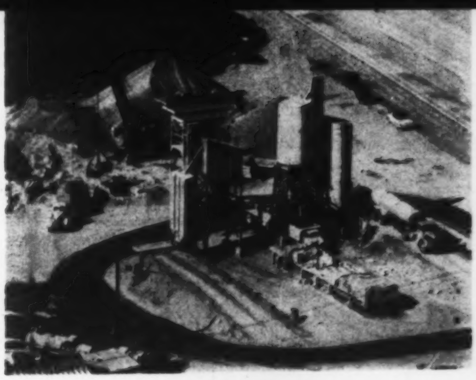
On the all-Canadian section of the seaway, concrete placing is done differently. St. Lambert Lock uses belt conveyors in a series of flights for much of the concreting, which is built up in alternate monoliths. European-type counterweighted hammerhead cranes place concrete in the Cote Ste. Catherine Lock.

Contractors on each side of the St. Lawrence look wistfully across at things being done on the other side which they would like to adopt. U.S. contractors would like more freedom on lift heights and the location of construction joints. And they would like to clean the top of a lift Canadian style, with less cutting required. The Canadians do not see why more water stops and seals are needed on their side.

The consensus among Canadian contractors, after watching the U.S. work and doing some of their own, is that 6½ ft is the optimum lift height for mass concrete. This permits the use of cantilever forms and is the economic maximum for that type. On the U.S. side, contractors agree that a 6½-ft lift would be cheaper and would speed the work—without loss of quality in the concrete they say.

Canadians say a reason for the greater use of wood forms on their work is the high cost of steel and the difficulty of getting it. Ironically many tons of gates and guides for the power development on the U.S. side come from Canada, some fabricated from European steel.

Competitive-bid contracts are keeping all the contractors on their toes. Many of them are trying to recoup losses from the unexpectedly high cost of earth moving in preparation for the concrete work. But the availability of workmen has been better than was expected this season, and a dry spring let work get off to a good start. There is a lot of concrete to be placed before cold weather but most projects will be on schedule for the opening dates on their part of the work.



In a rush operation, three pavers work on single lane to complete concreting before cold weather so that portable plant can be moved to new location for spring work.

Organization for contracts over $5,000,000

HOWARD G. DIXON, M. ASCE, Vice President, Johnson, Drake & Piper, Inc., New York, N. Y.

The greatest asset a highway contractor can have is an integrated mobile force that will go where the work is and "get the job going." An increasing number of civil engineers are a part of the contractor's organization for construction of modern highways, especially for contracts over 5 million dollars.

The part taken by engineers is shown graphically in Fig. 1. While some contractors may vary the line of authority and combine some of the work classifications, this basic organization will handle a large highway contract that extends over two working seasons. Only the contractor's key personnel that usually are carried on a yearly or seasonal basis are shown on the chart.

Quite frequently, the supervisory personnel have a following of foremen, mechanics, and the like. These men follow the contracting company from job to job and from state to state, and are usually found with a superintendent with whom they have formed a working alliance, often of many years' standing. These men are treated as one of the family by the contracting firm and their favorite superintendents; usually they lead the construction crews, more or less in the capacity of the old straw boss. Foremen and working crews ordinarily are obtained locally, through the unions, personal application, or public employment agencies.

Even in highly unionized urban areas it is usual for the local union business agent to allow a number of supervisors

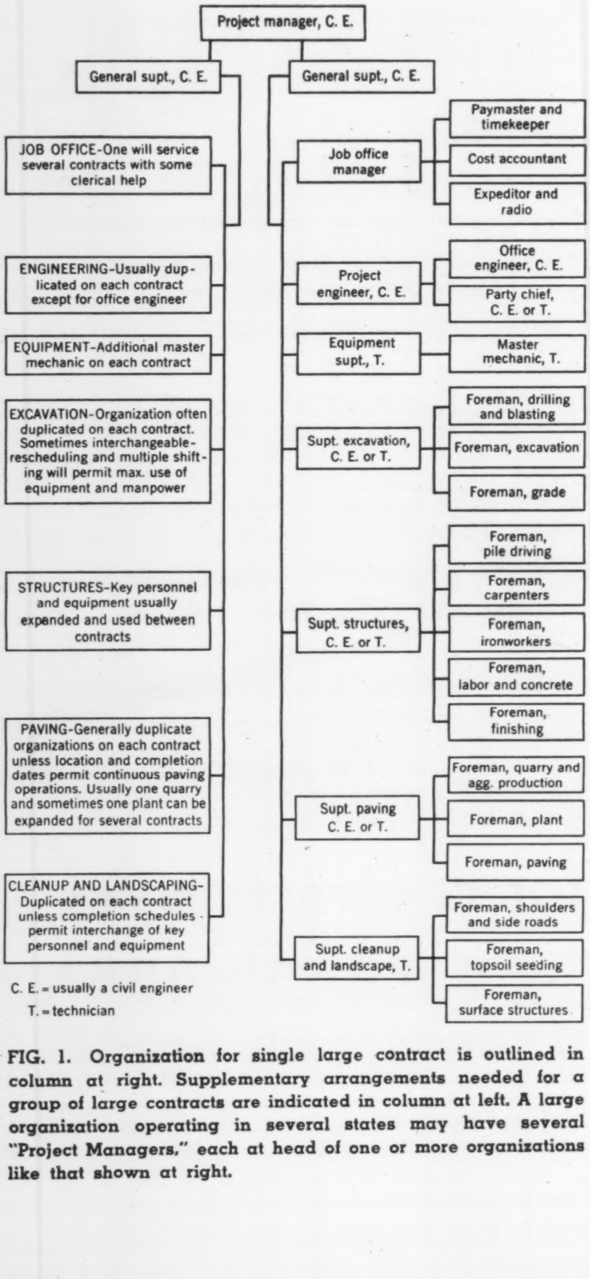

Project manager, C. E.
General supt., C. E.
General supt., C. E.
JOB OFFICE-One will service several contracts with some clerical help
ENGINEERING-Usually duplicated on each contract except for office engineer
EQUIPMENT-Additional master mechanic on each contract
EXCAVATION-Organization often duplicated on each contract. Sometimes interchangeable-rescheduling and multiple shifting will permit max. use of equipment and manpower
STRUCTURES-Key personnel and equipment usually expanded and used between contracts
PAVING-Generally duplicate organizations on each contract unless location and completion dates permit continuous paving operations. Usually one quarry and sometimes one plant can be expanded for several contracts
CLEANUP AND LANDSCAPING-Duplicated on each contract unless completion schedules permit interchange of key personnel and equipment
C. E. = usually a civil engineer
T. = technician
Job office manager
Paymaster and timekeeper
Cost accountant
Expeditor and radio
Project engineer, C. E.
Office engineer, C. E.
Party chief, C. E. or T.
Equipment supt., T.
Master mechanic, T.
Supt. excavation, C. E. or T.
Foreman, drilling and blasting
Foreman, excavation
Foreman, grade
Supt. structures, C. E. or T.
Foreman, pile driving
Foreman, carpenters
Foreman, ironworkers
Foreman, labor and concrete
Foreman, finishing
Supt. paving C. E. or T.
Foreman, quarry and agg. production
Foreman, plant
Foreman, paving
Supt. cleanup and landscape, T.
Foreman, shoulders and side roads
Foreman, topsoil seeding
Foreman, surface structures

FIG. 1. Organization for single large contract is outlined in column at right. Supplementary arrangements needed for a group of large contracts are indicated in column at left. A large organization operating in several states may have several "Project Managers," each at head of one or more organizations like that shown at right.

to transfer into his union to enable the contractor to maintain a smooth working organization. This assists the contractor in getting his work done efficiently and quickly and aids the union in the training of its members, adding to efficiency and safety.

In farm areas, where there is a limited supply of construction workers, it is necessary to bring in a much larger number of skilled workmen. In sparsely inhabited sections, construction camps are still in use. There specialists conduct camps on a subcontract basis at a charge per man for subsistence. Frequently the contractor subsidizes the camp operation to help maintain a supply of good men. Operation of the camp, either directly or on a subcontact basis, is a part of the job of the office manager.

In Fig. 1, a contractor's organization for road building is broken down into the operations of site clearing and excavation, structures, paving, clean-up and landscaping. There is an experienced superintendent in charge of each of these operations or combinations of them. Another superintendent is in charge of equipment. In addition there is the administrative function of job office manager, which includes purchasing, auditing, cost accounting, radio communication and expediting. The project engineer and his staff, including an office engineer, supply quantities necessary for cost control, do design of cofferdams, falsework and temporary structures, including plant layouts. Always there is a field crew for layout of the work. Line and grade for the permanent structures frequently are supplied by the owner's engineer, or his consulting firm. Depending on the provisions of the contract, the contractor may do all the layout, line and grade, which is checked periodically by the owner's engineers for control.

More engineers utilized

The growing use of the civil engineer in contractors' organizations is shown in this chart (Fig. 1). Jobs usually held by civil engineers and technicians are indicated by C.E. and T. respectively. With a growing trend towards specialization in engineering education and the variations in final job selection by graduate engineers, it is not uncommon to find electrical engineers, mechanical engineers, administrative engineers and the like in these positions. Most men like to build something. They are taught from childhood to become constructors with blocks, erector sets, toy trucks, power shovels, tractors, and the ever increasing model kits that help to make constructors of us all.

Because of the seasonal nature of the work, the constant moving from place to place required by work location, and the often short supply of skilled workers and key personnel, construction men as a group are higher paid than other industrial workers—from laborer to general superintendent. This fact, coupled with the intense competition among so many contractors doing the same type of work, has necessitated greater utilization of construction machinery.

Efficient organization is necessary to protect the ever-increasing working capital that is today invested in plant and equipment. Every man in the organization must possess knowledge of equipment performance in his particular part of the work. The equipment superintendent usually is a man who has been employed by the contractor long enough to know thoroughly all the construction plant, where it is located, its condition, age and proper maintenance.

Usually the equipment superintendent cannot be the master mechanic; the operators' union requires a master mechanic from its own locals in direct charge of maintenance and repair and to supervise the local operators of the machinery used on the work. The equipment superintendent quite frequently has come up through the union and elected to follow a contractor or general superintendent from job to job in a profitable cooperative working arrangement.

Avoiding "down time" is of top importance with the highly mechanized road-building operations of today. It is desirable to have supplemental equipment for all operations where economically practical. For tractors and trucks, this can require 15 to 25 percent of additional units, depending on the condition of equipment and the maintenance efficiency of the contractor's staff. Of even greater importance is keeping key equipment, such as a paver, in constant operation.

Steady job for good men

If the contractor is able to get continuing work, the usual procedure is for the specialist superintendent, for example on excavation, to move on to another job after his operation is completed on the first one. Under other circumstances the excavation superintendent may continue in another capacity and complete the clean-up and landscaping on his initial assignment.

The superintendent of structures may lay pipe at the start of the work while he is awaiting delivery of material for piling. Or he may arrive later, following the initial handling of drainage by the excavation superintendent.

On highway work paving is the big pay item. Every effort is made to get it under way. But paving cannot start until the finish grade is ready, subbase laid, and the like. The paving superintendent usually arrives in time to erect the asphalt or concrete plant. If the contractor produces his own aggregates, a crew will start stripping, quarrying and stockpiling stone or producing gravel and sand. Frequently concrete materials or asphalt mixes are purchased from commercial plants. Some larger paving jobs require a quarry superintendent, or such roadside operations may be subcontracted to specialists who move around the country with equipment for producing crushed stone, sand, gravel and asphaltic mixes.

District offices

Often a contractor will obtain several contracts in one area, which can be grouped and rescheduled for efficient and economical use of plant and organization. Fig. 1 also shows how this can be done. With a basic organization like that shown on the right, a project manager or the contractor himself would take over the work of coordinating these basic organizations, somewhat as shown on the left-hand side of the chart. This indicates how the various functions of the basic organizations can be interrelated with other jobs.

Instead of duplicating the entire staff needed for one contract, subsequent contracts can be handled with additional personnel as indicated in the boxes on the left side of the chart. Expansion of the overall organization required depends on progress requirements of the several contracts, the working capacity of the superintendents, and the volume of work items to be done. For example, if each of several contracts requires considerable structural work, then several structural superintendents will be needed.

A further grouping of contracts, more widely separated and encompassing several states, may be needed by a contractor engaged in meeting the huge national highway program. Such an enlarged operation requires a district manager (usually the contractor himself, a partner or officer in a large company) supervising several project managers or general superintendents, depending on the work load at each location. Each project manager will have under him one or more basic organizations like that shown in Fig. 1. The district office provides overall supervision to the job organization and is staffed to reduce some of the functions of the job office such as engineering and equipment management. It also directs the bidding and negotiation of new work in the area.

Safety depends on top organization

Good housekeeping is a must on successful highway projects. It is essential to quality workmanship and maximum production; it reduces mistakes and promotes efficient work and maximum safety.

Safety on a highway job can only be attained through the personal interest of the contractor and top personnel. Otherwise there is no chance of success. A safety program that works on highway projects is used by a large number of contractors. The program is initiated at the district management level or at the maximum level of the contractor's operations. This responsibility is passed down through job management, superintendents, and foremen, who are made aware of and held accountable for the performance of their individual organization. Monthly listings showing the relative standing of districts, jobs, superintendents, and foremen are invaluable to the program. They enable the individual to determine his performance in relation to others in similar operations and capacity.

An incentive feature serves to keep interest in the safety program alive at all levels. Safety awards are presented each year to district managers, project managers, superintendents, and field foremen who have achieved the best record in their respective divisions. Workmen supervised by the winning foremen receive cash awards, and foremen credited with a year without disabling injury among those under their supervision receive appropriate certificates. Proportionately greater honors are given those who have to their credit more years without disabling injury.

Some contractors' accident rates are as much as 80 percent below the national rates for similar construction activities. Aside from the humanitarian feature, there is a considerable reduction in insurance cost, which gives a safe working organization an advantage on every competitive bid. Already on a favorable rate basis, Johnson, Drake & Piper over a period of years has averaged a rebate of 25 percent on compensation insurance premiums.

A contracting organization, like a sensitive machine, must be carefully maintained, repaired when necessary, and added to as volume requires. The organization can become perennial and can undergo division to supply increases where necessary. This requires careful nurturing of understudies, apprentice training, summer employment of engineering students, and thoughtful recruiting for every box in Fig. 1.

The difference between just getting by and building an outstanding organization depends on the contractor's ability to inspire his men to give their best for the good of the entire organization. Wholehearted cooperation is necessary to meet schedules, keep overhead down, and hold production at a maximum. Loyalty for the contractor is built on a feeling of security, reasonable opportunity, and fair play. Successful contracting is possible only with this full cooperation.

More roads are planned in the immediate future. They will be built by more and better machinery operated by larger contracting organizations—for the large highway contract is likely to be $15 million instead of $5 million.

(This article is based on the paper presented by Mr. Dixon at the ASCE Buffalo Convention, before the Highway Division session presided over by Archie N. Carter, a member of the Division's Executive Committee.)

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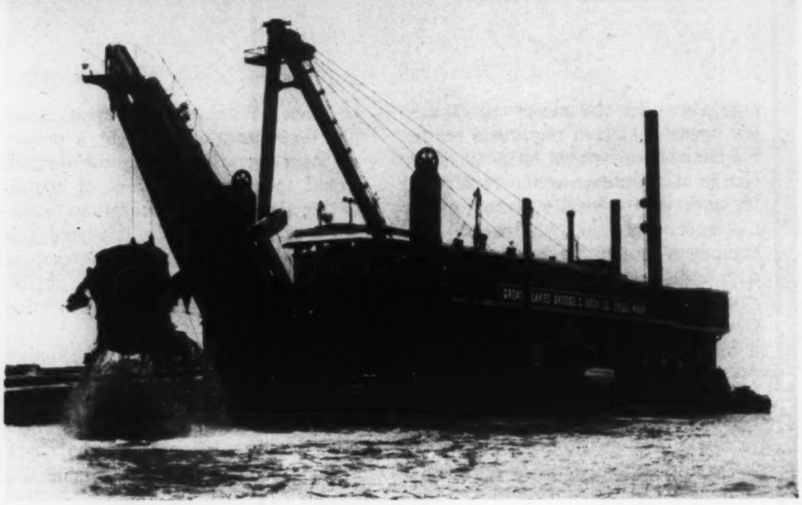


Dredge "Mogul" of Great Lakes Dredge and Dock Co. is seen excavating Lower Amherstburg Channel in May 1957.

Scheduling equipment for Great Lakes

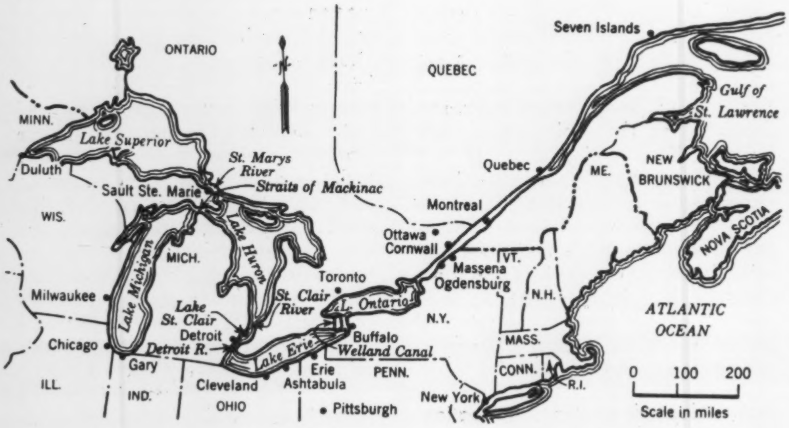

ONTARIO
QUEBEC
Seven Islands
Gulf of St. Lawrence
MINN.
Lake Superior
Duluth
St. Marys River
Sault Ste. Marie
Straits of Mackinac
Quebec
ME.
NEW BRUNSWICK
WIS.
Montreal
Ottawa
Cornwall
NOVA SCOTIA
MICH.
Lake Huron
Lake Michigan
VT.
Massena
Ogdensburg
Toronto
Milwaukee
St. Clair River
L. Ontario
N.H.
Lake St. Clair
N.Y.
ATLANTIC OCEAN
Detroit
Chicago
Detroit R.
Lake Erie
Buffalo
Welland Canal
MASS.
Gary
Erie
PENN.
CONN.
R.I.
0
100
200
ILL.
IND.
Cleveland
Ashtabula
OHIO
Pittsburgh
New York
Scale in miles

FIG. 1. Connecting channels to be deepened between Great Lakes total about 168 miles in length.

Opening of the St. Lawrence to ships of 25-ft draft has stimulated completion of deep-draft channels to all of the Great Lakes. Work now is authorized to complete 27-ft channels but funds must be provided for the $136,000,000 project. A limited amount of marine equipment is available on the Great Lakes. Economics requires scheduling the work to meet capabilities of the equipment. Fully as important is having money available to contract the jobs to keep the equipment working at optimum rates.

Connecting channels authorized to be deepened total 168 miles: in the St. Marys River between Lakes Superior and Huron, 63 miles; at the lower end of Lake Huron, 46 miles in the St. Clair River, 17 miles in Lake St. Clair, and 32 miles in the Detroit River, plus 9 miles out into Lake Erie. Shoals are to be removed in the Straits of Mackinac to provide better passage between Lakes Michigan and Huron. (The connection between Lakes Erie and Ontario is through the Welland Canal, now being deepened by Canada.) See Fig. 1.

Depths at present available are 18 ft for upbound ships and 21 ft for downbound, as much of the 100 million tons of shipments on the Lakes is ore and grain, all downbound.

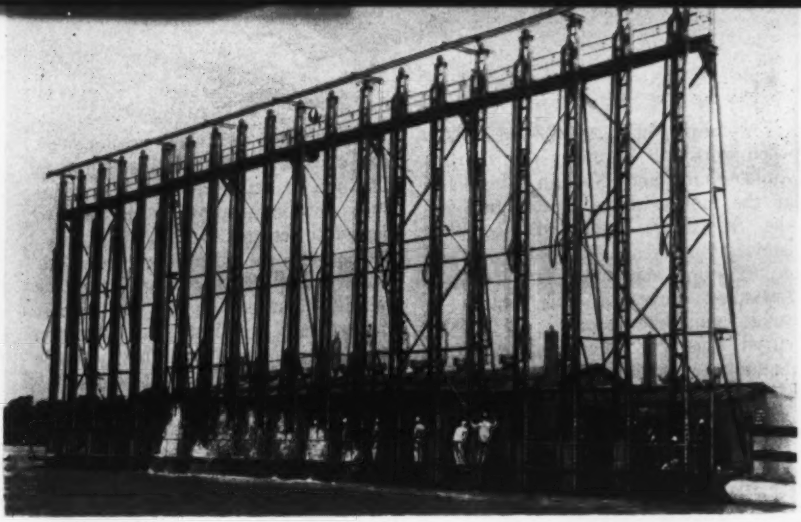
Incremental increase in draft is planned in all channels for each year so that vessels can increase the amount handled as conditions permit. Each additional foot of draft permits a large carrier to increase its annual earnings by $90,000. Average annual benefit to commerce from the increased depths in connecting channels will be in excess of $10 million.

Traffic must be maintained during deepening operations. Total amount to be moved is 18,500,000 cu yd by hydraulic dredge and 28,500,000 cu yd by other dredges. This includes 1 ft of pay overdepth and 15 percent of estimated total pay quantity added for non-pay overdepth dredging. Past experience indicates that to obtain a "swept grade," contractors must excavate 14 to 18 in. below the required grade to allow for equipment inaccuracies and to insure against redredging.

Moving this large amount economically requires close scheduling to keep equipment and crews busy constantly and still avoid peaks that demand bringing in considerable extra equipment. Such scheduling shows the appropriations required from the U. S. Congress and aids in obtaining such funds at the time needed.

Unused capacity available

An independent study was made by a well-known certified public accountant for the National Association of Rivers & Harbors Contractors, based on information submitted by six of the major dredging companies in the United States. This study developed the information that only 41



Twenty-frame drill rig of Marine Operators works in Upper Amherstburg Channel in May 1957.

channel dredging

percent of the total available capacities of these companies was utilized on government and private work during 1946-1955 inclusive. Of this work, 60 percent was for the U. S. Government and 40 percent for private industry.

Maintenance work on U. S. Government projects in the Great Lakes area in 1957-1963 will continue about as in the past ten years. New work—authorized, funded, and proposed—substantially exceeds the average annual new work accomplished by plant of smaller capacity than that listed in Table I, and by land plant.

Completion of the St. Lawrence Seaway in 1959, and the Connecting Channels in 1962, will increase substantially the amount of other than Federal Government dredging in 1957-1963, but much of this work too can be carried out by plant of smaller capacity. About 60 percent of the capacity of the available fleet, as listed in Table I, will be available for work on the Great Lakes Connecting Channels with some allowance for improvement to Great Lakes harbors.

An inventory of major items of dredging equipment available on the Great Lakes has been made and analyzed. It includes: (1) hydraulic dredges; (2) one dipper dredge; (3) clamshells, bucket dredges, and draglines; (4) drill boats; and (5) dump scows.

Determining dredge capacities

An attempt has been made to establish capabilities for each dredge listed as available, using records of the Detroit District, Corps of Engineers. For example the performance record on the Great Lakes Dredge & Dock Company's dredge *Mogul*, on five jobs other than rock, averages 311 cu yd per hour, or 186,000 cu yd per 600-hour month. On one job, in clay, it averaged 391 cu yd per hour; in another, in clay, sand and boulders, 400 cu yd; on another, in clay, sand, compact material, 251 cu yd; and on still another, in clay and gravel, 256 cu yd. The average of 311 cu yd per hour was reduced by 20 percent for moving between jobs, for possible reduced efficiency, and because average conditions will not be ideal for the *Mogul*. For it therefore, in other than rock, a capability of 150,000 cu yd per month is used. In drilled and blasted rock its capability is taken as 80,000 cu yd per month.

Available records for the hydraulic dredge *Niagara* gave the following

TABLE I. Available major dredging equipment, Great Lakes area

Hydraulic dredges, 16-in. or over

DREDGE AND OWNER	PIPELINE SIZE, IN	PUMP HP	EXCAV. CAPAC. PER MO., CU YD
Illinois, Great Lakes Dredge & Dock Co.	30	3,500	250,000
Niagara, Duluth-Superior	22	2,400	225,000
Three Brothers, Price Bros-McClung	18	1,800	200,000
Alice Loraine, Control State Dredging	18	....	150,000
Ohio, Great Lakes Dredge & Dock Co.	16	500	130,000
Total			955,000

Dipper dredges and draglines, 4 cu yd or over

DREDGE AND OWNER	DIPPER, CU YD	CAPAC. PER MO., CU YD	
		Rock	Other
Sampson, Marine Operators (dragline)	12	90,000	160,000
Mogul, Great Lakes Dredge & Dock Co.	12	80,000	150,000
Old Hickory, Duluth-Superior	11	60,000	102,000
No. 9, Great Lakes Dredge & Dock Co.	10	60,000	120,000
Hellgate, Merritt-Chapman Scott	10	60,000	120,000
M. Sullivan, Merritt-Chapman Scott	9	60,000	120,000
No. 7, Great Lakes Dredge & Dock Co.	8	55,000	100,000
Warhorse, Great Lakes Dredge & Dock Co.	8	55,000	100,000
Chicago, Great Lakes Dredge & Dock Co.	8	70,000	120,000
No. 6, Fitz Simmons & Connell	8	55,000	85,000
Omadon, Dunbar-Sullivan	7	50,000	72,000
Buffalo, Great Lakes Dredge & Dock Co.	5½	40,000	60,000
No. 27, Zenith Dredging	5	35,000	50,000
Tipperary Bay, Dunbar-Sullivan	4	35,000	50,000
Ring Coal, L. A. Wells	4	35,000	50,000
Totals		840,000	1,460,000

Clamshells and bucket dredges

DREDGE AND OWNER	BUCKET, CU YD	EXCAV. CAPAC. PER MO., CU YD
No. 53, Great Lake Dredge & Dock Co.	5-12	64,000
No. 55, Great Lakes Dredge & Dock Co.	5-12	64,000
No. 56, Great Lakes Dredge & Dock Co.	5-12	64,000
Gotham, Merritt-Chapman & Scott	6	55,000
Four Spot, Merritt-Chapman & Scott	4½	50,000
Ojibway, Fitz Simmons & Connell	4	50,000
Handy Andy, Dunbar-Sullivan	4	50,000
Wauhassee, L. A. Wells	4	50,000
Wellston, L. A. Wells	4	50,000
Five Spot, L. A. Wells	4	50,000
Total		547,000

values for cubic yards per hour on different jobs: 323 in clay, sand, and compacted material; 1,100 in soft clay and sand; 562 in sand and clay; 507 in clay and sand; and 506 in clay, sand and gravel. The average of four jobs (excluding the 1,100-cu yd per hour job) was 475 cu yd per hour, or 285,000 per month. Reducing this by 20 percent for moving between jobs, possible reduced efficiency, and lack of ideal conditions, gives the adopted capability of 225,000 cu yd per month.

In like manner the capabilities of other plant that worked in the Detroit District were computed. If no district experience was available, the estimate was based on available information. A few totals are given in Table I, taken from the detailed plant inventory and estimated average capacities.

The channel "east of the Detroit River Light" extends far into Lake Erie, is subject to heavy weather, and has a bottom material of silt and unconsolidated sand. The only practical plant for excavating economically in this open area is a sea-going hopper dredge. No contractor-owned dredge of this type is available on the Great Lakes. The Corps of Engineers is designing a hopper dredge with a capacity of at least 1,500,000 cu yd per season at normal unloading distances. This dredge will be ready by June 1959.

Existing dredge capacity on the Great Lakes is outlined in Table I. Adding the hopper dredge now under construction, the schedule of Table II was made up. Since some years will require a very large percentage of one type of dredging equipment, additional machines may be attracted.

The years 1958, 1959, and 1960, when work will be under way in the Amherstburg and Neebish Channels, at the foot of Lake Huron, and in the St. Clair River, will be the heaviest use years for the available dump scows and tugs. In 1958, the scheduled excavation will require a total dump-scow capacity of 14,000 cu yd. This is 53 percent of the Great Lakes scow capacity available for the Connecting Channels project, working with 7 separate dipper dredges. In the peak year 1960, the scow requirement will be increased to 24,000 cu yd, or 80 percent of the available scow capacity.

Dredging contractors with available scows, dipper dredges, and tugs are more interested in placing their dredges at work on jobs that will also employ their scows and tugs to full capacity. A new 1,500-cu yd dump scow costs $300,000, or $200 per cu yd of carrying capacity. In scheduling the project, it is necessary to coordinate excavation capabilities with scow availability to attract the complete equipment required.

An additional major excavation project, authorized as a part of the deepening of the connecting channels, is known as the South East Bend Cut-off. This cut-off canal 27.1 ft deep, 6 miles long, and 700 ft wide, lies entirely in Canada and cuts through Indian lands. It was authorized and will be constructed provided the lands and authorization to construct it are received from the Canadian Government before construction starts in the South East Bend reach. If started in the spring of 1958, the 21,000,000 cu yd involved can be excavated by June 1961 by a high-capacity 30-in. hydraulic dredge or several smaller ones. The material is suitable for pumping. The job is attractive enough to induce new large-capacity dredges to come into the area.

TABLE II. Dredging schedule, in units of 1,000 cu yd

Fiscal Year*	By Dipper or Clam		By Hydraulic Method	By U.S. Hopper Dredge	% of Available Great Lakes Capacity Required
	Rock	Other			
1957	172†	....	....	....	....
1958	2,620	1,718	4,233	....	68% of dipper and clam and 98% of hydraulic
1959	2,100	3,488	4,000	1,000	77% of dipper and clam, 93% of hydraulic, and all of U.S. hopper dredge
1960	1,000	6,568	1,000	1,800	92% of dipper and clam, 28% of hydraulic, and all of U.S. hopper dredge
1961	230	1,633 +12‡	3,000	1,800	36% of dipper and clam (24% on excavation, 12% on sweeping and shoal removal), 72% of hydraulic, and all of hopper dredge
1962	230	3,913 +175‡	500	1,000	95% of dipper and clam (50% on excavation, 45% on sweeping and shoal removal), 12% of hydraulic, and 70% of hopper dredge
1963	....	4,889 +67‡	....	....	59% of dipper and clam

---

* Fiscal year 1957, for example, is July 1, 1956, to June 30, 1957.

† Total through June 1957.

‡ To be swept and cleared by dipper and clamshell dredges in areas not requiring continuous dredging.

Congressional appropriation for prosecution of this work on the schedule outlined is of the utmost importance. A substantial reduction in allocation one year cannot be made up the next year. Of the total estimated cost of $136,000,000 (exclusive of the South East Bend Cut-off), only $5,000,000 has been made available. An appropriation of $20,000,000 is required in the fiscal year 1958 to permit continuation according to schedule.

Work under way

The first two contracts awarded on the Amherstburg Channel (in the Detroit River) went to Marine Operators, a combine of the Al Johnson Construction Co., Peter Kiewit Sons' Co., Morrison-Knudsen Co., Inc., and Cunningham Kiewit Co. The contracts aggregate $16,322,548 for excavation of 1,917,200 cu yd of ledge rock and overburden. A third contract has been awarded to the Great Lakes Dredge and Dock Co. for $6,566,040 to excavate 897,000 cu yd of ledge rock, overburden, and clay, sand and boulders. Contracts are awarded on the "continuing contract" basis. A definite amount is allocated to the contract for the current fiscal year, and remaining contract expenditures are contingent on annual Congressional appropriations.

Great Lakes Dredge and Dock Co. is drilling with a 4-frame drill rig, excavating with the 12-cu yd dipper dredge *Mogul,* and loading excavated material into dump scows. Marine Operators are drilling with a 20-frame drill rig, excavating with a 12-cu yd bucket dragline, equipped with a 160- or 200-ft boom. It is mounted on a 175 x 65-ft scow equipped with three 145,000-lb spuds. Material will be loaded on flat scows, towed to a dike disposal area, and unloaded with a 6-cu yd dragline. Capacities of the two plants are expected to be about the same, about 80,000 to 90,000 cu yd of full pay material per month. Drilling capacities anticipated are 2,500 to 3,000 holes per month with the 4-frame drill rig, and up to 9,000 per month with the 20-frame rig.

Advantages and disadvantages of each type of equipment will be learned on this job. Results of working the same materials by different methods by two contractors, each with excellent equipment and experienced supervision, will be of great interest to the dredging industry.

Construction begins on Glen Canyon Dam

W. A. DEXHEIMER, M. ASCE, Commissioner, Bureau of Reclamation, Washington, D. C.

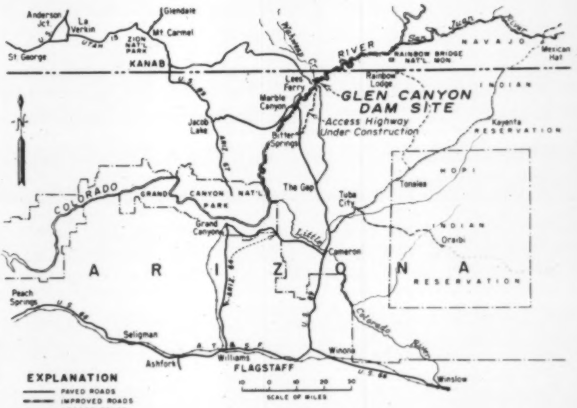
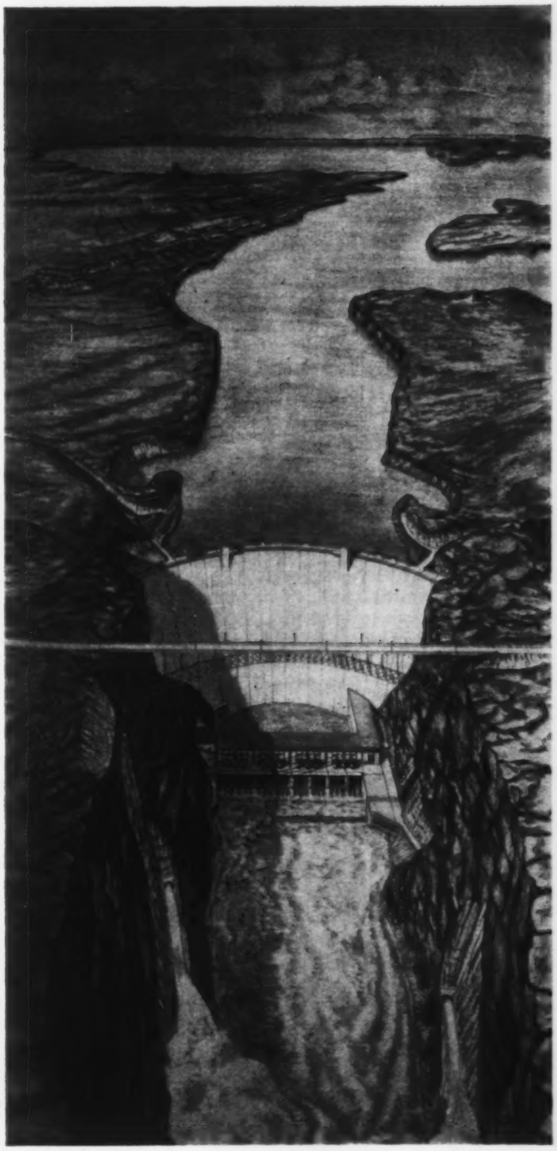

Anderson Jct.
La Verkin
Glendale
Mt Carmel
St George
UTAH 15
ZION NAT'L PARK
KANAB
U.S. 89
Lees Ferry
Marble Canyon
Jacob Lake
ARIZ. 67
Bitter Springs
RIVER
San Juan River
Wahweap Cr.
RAINBOW BRIDGE NAT'L. MON
Rainbow Lodge
GLEN CANYON DAM SITE
Access Highway Under Construction
NAVAJO
Mexican Hat
INDIAN
Kayenta
RESERVATION
N
HOPI
Tonalea
COLORADO
GRAND CANYON NAT'L PARK
The Gap
Tuba City
Grand Canyon
Little
Cameron
INDIAN
Oraibi
A R I Z O N A
RESERVATION
ARIZ. 64
U.S. 89
Colorado River
Peach Springs
U.S. 66
Seligman
A.T. & S.F.
Ashfork
Williams
FLAGSTAFF
Winona
U.S. 66
Winslow
EXPLANATION
PAVED ROADS
IMPROVED ROADS
GRADED ROADS
DIRT ROADS
10 0 10 20 30
SCALE OF MILES

FIG. 1. Glen Canyon Dam site is on Colorado River, about 12 miles downstream from Arizona-Utah state line. In artist's drawing, note nearly vertical canyon walls, which rise to height of 650 ft at site.



A vast isolated area of the Western United States is to be opened up for the enrichment of the nation. In one of the least accessible, most sparsely inhabited areas of the country a giant water conservation dam and reservoir are under construction. (See map, Fig. 1.) The key to the unlocking of the 110,000-sq-mile area, rich in agricultural, industrial, and recreational potential, is Glen Canyon Dam, a major feature of the Bureau of Reclamation's Colorado River Storage Project. The conservation of water and

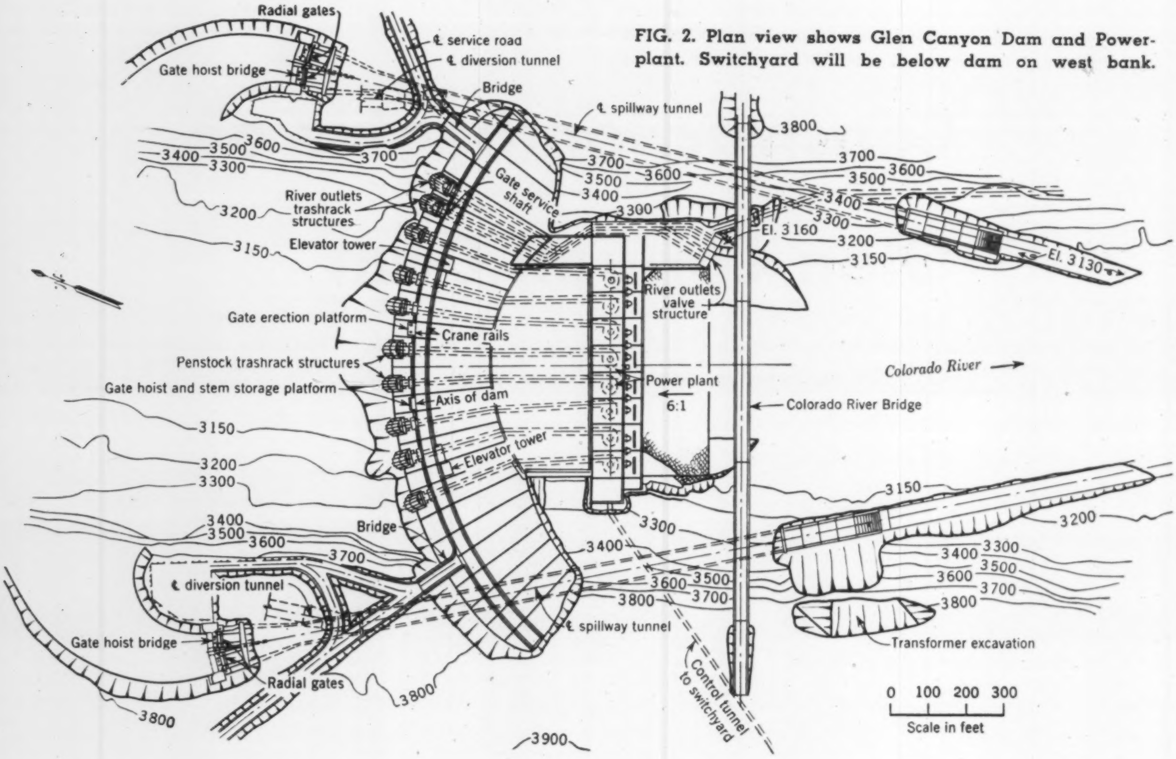
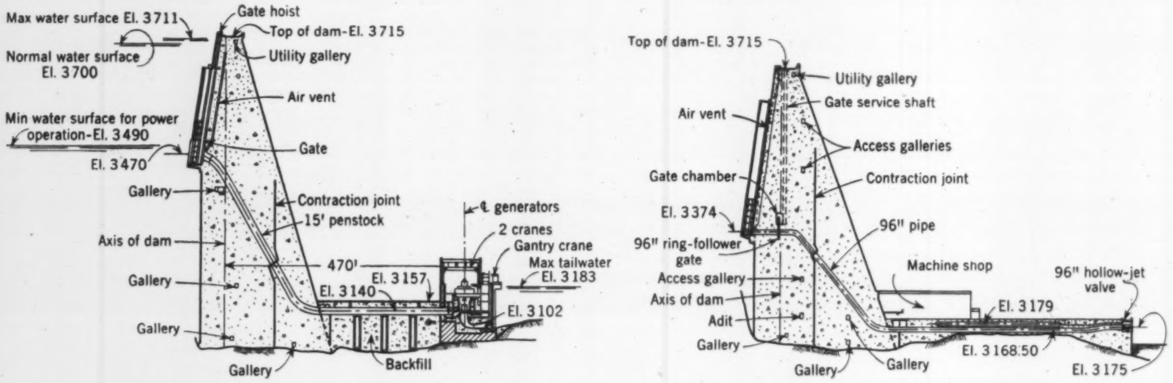

Radial gates
Gate hoist bridge
℄ service road
℄ diversion tunnel
Bridge
℄ spillway tunnel
3800
3700
3600
3500
3400
3300
3200
3150
Gate service shaft
River outlets trashrack structures
Elevator tower
El. 3160
El. 3130
River outlets valve structure
Gate erection platform
Crane rails
Penstock trashrack structures
Gate hoist and stem storage platform
Axis of dam
Power plant
6:1
Colorado River
Colorado River Bridge
Elevator tower
Bridge
℄ diversion tunnel
Gate hoist bridge
Radial gates
℄ spillway tunnel
Control tunnel to switchyard
Transformer excavation
0 100 200 300
Scale in feet
3900

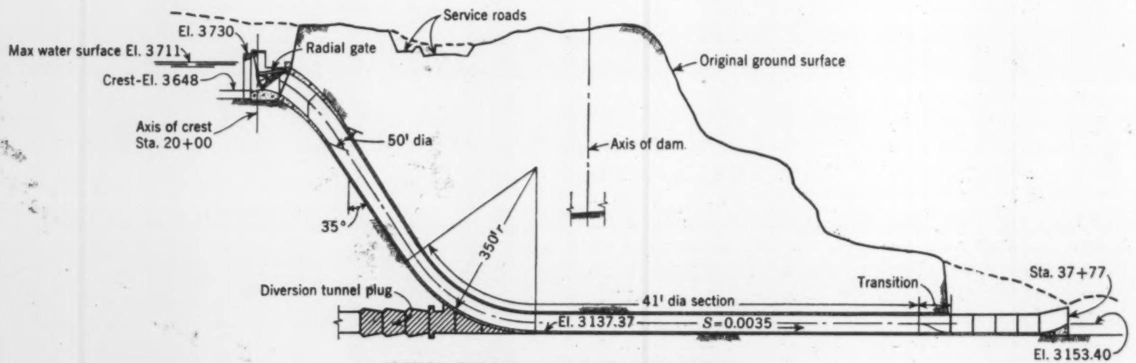
FIG. 2. Plan view shows Glen Canyon Dam and Powerplant. Switchyard will be below dam on west bank.

FIG 3. Sections show dam and spillway tunnel.


Max water surface El. 3711
Gate hoist
Top of dam-El. 3715
Normal water surface El. 3700
Utility gallery
Air vent
Min water surface for power operation-El. 3490
Gate
El. 3470
Gallery
Contraction joint
15' penstock
Axis of dam
℄ generators
2 cranes
Gantry crane
470'
Max tailwater El. 3183
Gallery
El. 3157
El. 3140
El. 3102
Gallery
Gallery
Backfill
Top of dam-El. 3715
Utility gallery
Gate service shaft
Air vent
Access galleries
Gate chamber
Contraction joint
El. 3374
96" pipe
96" ring-follower gate
Access gallery
Machine shop
96" hollow-jet valve
Axis of dam
El. 3179
Adit
Gallery
El. 3168.50
Gallery
Gallery
El. 3175

SECTION THROUGH PENSTOCK AND POWER PLANT

SECTION THROUGH RIVER OUTLETS


Service roads
El. 3730
Radial gate
Max water surface El. 3711
Original ground surface
Crest-El. 3648
Axis of crest Sta. 20+00
50' dia
Axis of dam
35°
350' r
Diversion tunnel plug
Transition
Sta. 37+77
41' dia section
El. 3137.37
S=0.0035
El. 3153.40

SECTION THROUGH RIGHT SPILLWAY TUNNEL

TABLE 1. Glen Canyon Project —physical data

Dam:	
Type	Concrete arch
Height above river bed, ft	580
Height above lowest point in foundation, ft	700
Crest length, ft	1,500
Crest width (width of roadway), ft	35
Base width, ft	300
Concrete in dam, cu yd	4,770,000
Crest elevation	El. 3715
Max. discharge through spillways, cfs.	276,000
Reservoir:	
Capacity, acre-ft at normal water surface, El. 3700	28,000,000
Area, acres as normal water surface	164,000
Elevation of max. water surface	El. 3711
Length, miles	186
Powerplant:	
Capacity, kw.	900,000
Number of units	8
Capacity of each generator, kw	112,500
Capacity of each turbine, hp.	155,500

TABLE II. Building costs for Hoover and Glen Canyon Dams compared

Typical Major Pay Items	Unit Price by Low Bidder, per cu yd*	
	Hoover Dam (1931)	Glen Canyon Dam (1957)
Mass concrete in dam (does not include cost of cement)	$2.70	$10.25
Excavation, common, for dam and powerplant foundations	2.20	1.95
Excavation, rock, for dam foundation	4.40	3.25
Excavation, all classes, in diversion tunnels	8.50	20.00
Excavation, all classes, in open cut for spillways	2.60	4.00
Concrete in lining of diversion tunnels	11.00	36.50

*Cost index, based on 1931 = 100. Hoover Dam = 100; Glen Canyon = 295.

TABLE III. Glen Canyon Dam and Powerplant—principal quantities

Excavation, cu yd:	
Common, for dam and powerplant	985,000
Rock, for dam and powerplant	1,650,000
All classes, in open cut for spillways.	950,000
All classes, in spillway tunnels	132,000
All classes, in diversion tunnels	182,000
Concrete, cu yd:	
In dam	4,770,000
In spillway and diversion tunnel lining	110,000
In appurtenant structures, except powerplant	155,000
In powerplant	157,000
Reinforcement, lb.	28,900,000
Tubing and fittings:	
For grouting, lb	755,000
For cooling concrete, lin ft	4,650,000
Spillway radial gates and hoist, lb	1,950,000
Penstock and outlet pipes, lb	21,000,000
Fixed-wheel gates and hoists for penstocks, lb	3,180,000
Ring-follower gates and hollow-jet valves for outlets, lb	1,300,000
Trashrack metalwork, lb	1,880,000
Structural steel for powerplant superstructure, lb	4,250,000

hydroelectric power production from the Colorado River will make possible the development of irrigable lands and huge resources of fuel, oil, minerals, uranium, and timber.

Urgently needed water in this semi-arid region will also be supplied to municipalities. Other benefits will be recreation, fish and wildlife conservation, and sediment retention and river regulation.

Dam contract awarded in April

Construction of Glen Canyon Dam and a 900,000-kw powerplant began a year after the project was authorized by the Congress. Award of the contract for construction of the dam and powerplant was made on April 29, 1957, to the Merritt-Chapman & Scott Corporation of New York under its bid of $107,955,522—the largest single contract of record for construction of a dam, and the largest contract ever awarded by the Bureau of Reclamation.

Glen Canyon Dam, to rise 700 ft above its foundation—second in height only to the 726-ft Hoover Dam—is on the Colorado River in Arizona, about 15 river miles upstream from Lees Ferry and 12 river miles downstream from the Arizona-Utah state line. It is about 370 miles upstream from Hoover Dam on the Colorado River. The remote dam site is in a narrow, straight-walled section of Glen Canyon, one of the striking canyons cut by the Colorado River. The sides of the canyon at the site rise abruptly from the bed of the river in nearly vertical walls 650 ft high.

The dam will be a concrete arch structure having a volume of 4,770,000 cu yd, a crest length of 1,500 ft, and a thickness at the base of 300 ft. See Figs. 2 and 3. Other physical data are given in Table I.

Glen Canyon Dam will create a huge reservoir of 28,000,000-acre ft capacity, extending 186 miles up the Colorado River and 71 miles up the San Juan River, a major tributary of the Colorado. The reservoir, together with the other storage units of the Colorado River Storage Project, will provide holdover reserves of water to meet the requirements of the 1922 Colorado River Compact.

The dam and powerplant are the principal features of the Glen Canyon Unit, which also includes access roads, a switchyard, and the Colorado River Bridge, shown in the accompanying artist's drawing and in Fig. 2. The new permanent community will be established at Page, Ariz., named after the late John C. Page, Hon. M. ASCE Commissioner of Reclamation from 1937 to 1943. The community is to house both the contractor forces during construction and the Bureau's administrative and engineering personnel, and subsequent operation and maintenance forces.

Total cost of construction of the Glen Canyon Unit, without transmission facilities, is estimated at $300,000,000. Construction will require a total of about 80 million man-hours of labor, of which 27 million man-hours will be at the dam site. The balance of 53 million man-hours will be for production of materials, transportation, and administration. Materials such as iron and steel, aluminum, cement, and lumber, must be obtained from far-flung sources.

Costs have tripled

Construction costs for large concrete dams have approximately tripled in the 26 years since the construction of Hoover Dam. Rates for common labor have increased from about $0.50 per hour to $2.25 per hour, and for skilled labor, from about $0.75 per hour to $3.45 per hour. Cement prices have increased from about $1.40 a barrel to $3.50 a barrel (f.o.b. mill), and structural steel shapes from about $33 a ton to $115 a ton (f.o.b. mill). Construction machinery and equipment also have tripled in cost during this period. Table II shows a comparison of the low bids for several of the major pay items for both Hoover and Glen Canyon Dams.

Table III lists the principal quantities required for construction, including spillways, outlets, and powerplant. Most of these materials will be supplied and installed by the contractor during the period of construction, which is expected to extend over about seven years. The Bureau will purchase specially designed machinery and equipment under separate advertisements, as well as about 3 million bbl of cement and approximately 240,000 tons of pozzolan.

The remoteness of the dam site and its distance from the railhead imposed the major problem of providing adequate access roads. The dam site is 135 miles from Flagstaff, Ariz., the nearest railhead, and approximately 80 miles from the nearest established community, Kanab, Utah. Before construction began, the site could be reached only by an unimproved road from Kanab to the Utah-Arizona state line, the remaining 7 miles being passable only by jeep. The nearest means of access on the southeast side of the river was an unimproved road running northeast from The Gap, about 50 miles from the dam site.

Following authorization of the project, a one-lane road was rough-graded by the Arizona Highway Department

First major construction at site was for west diversion tunnel, begun in October 1956, under $2,452,340 contract with Mountain States Construction Co., Denver. In view above, jumbo attacks rock face to drill 165 to 205 holes per round, each 12 ft long. Photo below shows holed-out tunnel, 43½ ft in diameter, with air pipe at right.

Thirteen-ton dump truck (8-cu yd) is lowered into Glen Canyon by cableway, for use in excavating west diversion tunnel. Photo looks upstream from canyon rim.

over Indian trails from The Gap road to the dam site. Subsequently the Bureau entered into an agreement with the State of Arizona for construction and maintenance of a 25-mile highway to the dam site. The highway is to be part of a permanent alternate U. S. Highway 89, connecting at Kanab, Utah, and Bitter Springs, Ariz., a distance of about 96 miles. See Fig. 1.

The highway is being constructed under two contracts—a 4½-mile section running from Bitter Springs, under a $1,156,234 contract held by the Strong Company of Springville, Utah; and a 20-mile section, completing the highway to the Colorado River Bridge site, under a $1,011,819 contract awarded to W. W. Clyde & Company, also of Springville, Utah. Both contracts are for construction up to subgrade and are expected to be completed by July of 1957. Bituminous surfacing of the highway, to be carried out under a separate contract, is scheduled for completion by September.

On the northwest side of the river, the Bureau has constructed a temporary access road from the dam site to the Utah-Arizona state line, and the State of Utah has improved the road to Kanab. The State of Utah is now constructing a permanent highway from Kanab to the state line, and the State of Arizona will construct a permanent highway from the state line to the dam site.

Colorado River Bridge

Construction of the Colorado River Bridge was begun in January of this year under a $4,139,277 contract awarded to Kiewit-Judson Pacific Murphy of Emeryville, Calif. The bridge, 865 ft downstream from the dam axis, is a single-span steel arch and is to cross the Colorado River about 700 ft above river level. It will be the highest and second longest of its type in the United States. It has an over-all length of 1,271 ft, including abutments, and an arch span of 1,028 ft. The bridge will have a 30-ft reinforced concrete roadway and a 4-ft sidewalk on each side of the roadway. The bridge is scheduled to be completed in February 1959.

First major construction at the dam site began in October 1956 under a $2,452,340 contract awarded to Mountain States Construction Company, Denver, for construction of the right (west) diversion tunnel. The contractor for this work has erected an aerial cableway across the canyon which is capable of ferrying men and materials from one side to the other or between the canyon rim and the river. Tractors, motor scrapers, and other heavy equipment have been lowered to the tunnel portal area by this cableway. The bridge contractor is stringing a separate cableway. At other points along the rim, on each side of the canyon, the Mountain States Construction Company and other contractors have erected vertical-lift cables and cages to lower men and equipment for drilling and blasting and for surveying.

Construction of the left tunnel and completion of both tunnels are included in the prime contract for construction of the dam and powerplant. The tunnels vary in diameter from 43½ ft in the upstream part to 46½ ft in the downstream part. The right tunnel is 2,740 ft long, and the left tunnel, 2,900 ft long.

The contractor for the dam and powerplant is required to erect and maintain a complete concrete plant, including equipment for processing, conveying, and stockpiling concrete aggregates; storage and handling facilities for both cement and pozzolan; mixing and batching facilities; and refrigerating equipment for cooling aggregates and mixing water. Aggregates, obtained from a Government-owned deposit about 10 miles from the dam, will require washing and some wastage to obtain the desired quality and grading. Because the aggregates are reactive with the alkalis in cement, and for economy, a pozzolan will be used in the concrete.

The interior or major part of the dam will be made of concrete containing approximately 2 sacks of cement and 1 sack of pozzolan per cu yd. This is a radical change from the mix used at Hoover Dam, where 4 sacks of portland cement per cu yd—with no pozzolan—were used.

The dam will be divided into columns or blocks by radial and circumferential contraction joints. Blocks shown in the specifications range in width from 40 to 70 ft at the axis of the dam, and in length from 130 to 190 ft. The contractor has the option of placing the concrete in either 5- or 7½-ft lifts.

The prime contractor will probably start excavation of the left diversion tunnel as soon as men and equipment can be assembled, and living quarters and construction facilities provided. About six months later, or in December 1957, excavation of rock for the dam abutments will be in progress above the river water level. Concrete lining of the right diversion tunnel will probably start in January 1958.

On completion of lining of the right diversion tunnel, the lining will be started in the left diversion tunnel, which will have been excavated by that time. Before the left tunnel lining is completed, cofferdams will be constructed in the river channel during the low-water season in November 1958, and the river will be diverted through the right diversion tunnel. Lining of the left tunnel will be completed in time so that high water can be passed through both tunnels in the spring of 1959.

As soon as the river has been diverted into the right diversion tunnel, the dam site between the cofferdams will be pumped dry and the excavation remaining below normal water level will be completed. Immediately following exposure and final cleanup of the solid rock foundation in the deepest part of the excavation, it is expected that the first concrete will be placed in the dam, about September 1959.

The contractor will probably install an overhead cableway system spanning the dam and powerplant area. Cableways will be used in handling construction equipment, removing excavated material, setting concrete forms, and for placing concrete and other materials.

Concrete placing in the dam will require about 3½ years of virtually continuous operation. Final placement will probably be made in January or February of 1963. Other work will continue on through the remainder of that year. Construction of the powerplant, spillway, transmission facilities, and other associated work will be carried on throughout the construction period.

The Bureau will commence storage behind the dam in about four years. Releases, controlled by the Bureau in accordance with downstream commitments, will be made to the river during the first storage period through temporary gates in the left diversion tunnel, followed by releases through the river outlets. The river outlets, consisting of four steel conduits, 96 in. in diameter, are on the left side of the dam.

Two spillways provided

In addition to the water flow through the powerplant turbines and outlet pipes, two spillways, one on each side of the dam, will be provided, utilizing part of the diversion tunnels, as shown in Fig. 3. Crests of the entrance channels for the spillway tunnels will be controlled by two 40- by 52.5-ft radial gates for each tunnel. Ski-jump buckets at the downstream ends of the spillway will raise the water so that it will be deflected into the center of the river channel.

Glen Canyon Powerplant is to be constructed about 470 ft downstream from the axis of the dam. It will be a reinforced concrete structure 665 ft long, 113 ft wide, and 150 ft high above foundation. The powerhouse structure will be a structural steel frame having reinforced concrete enclosure walls. The powerplant will have an ultimate installation of eight 112,500-kw generating units, each driven by a 155,500-hp turbine. Each unit will receive water through a 15-ft steel penstock embedded in the dam and spanning the distance between the toe of the dam and the powerhouse on concrete piers.

The new community of Page, Ariz., will be constructed on a mesa approximately 2 miles southeast of the dam. Plans call for commercial facilities and services to be supplied by private parties and capital. During the construction period, the population of Page may reach 10,000 persons. This will reflect the employment of 3,000 to 4,000 persons by the contractor and the Government. After completion of major construction, the town will have a permanent population of about 4,000.

The contractor will build housing facilities and certain other facilities as may be necessary for his forces. The Government will construct housing and will also encourage private financing to provide housing for Government employees. Areas will be available for development of businesses by private firms and individuals by leasing.

The Federal Government will encourage the incorporation of the new community under the laws of Arizona, as early as practicable. Utilities and services, including a domestic water supply, sewage disposal system, and liquefied petroleum gas, electricity, and telephones, are to be made available at the earliest practicable time. The sewage disposal plant is expected to be in operation by November 1957, and the domestic water supply system in partial operation by April 1958. A grade school, a high school, and a hospital are also to be built and equipped.

The Colorado River Storage Project also includes the Flaming Gorge Dam and Powerplant on the Green River in Utah, Navajo Dam on the San Juan River in New Mexico, and the Curecanti Unit on the Gunnison River in Colorado. The four storage units will have a total reservoir capacity of about 34,500,000 acre-ft and an installed generating capacity of about 1,100,000 kw.

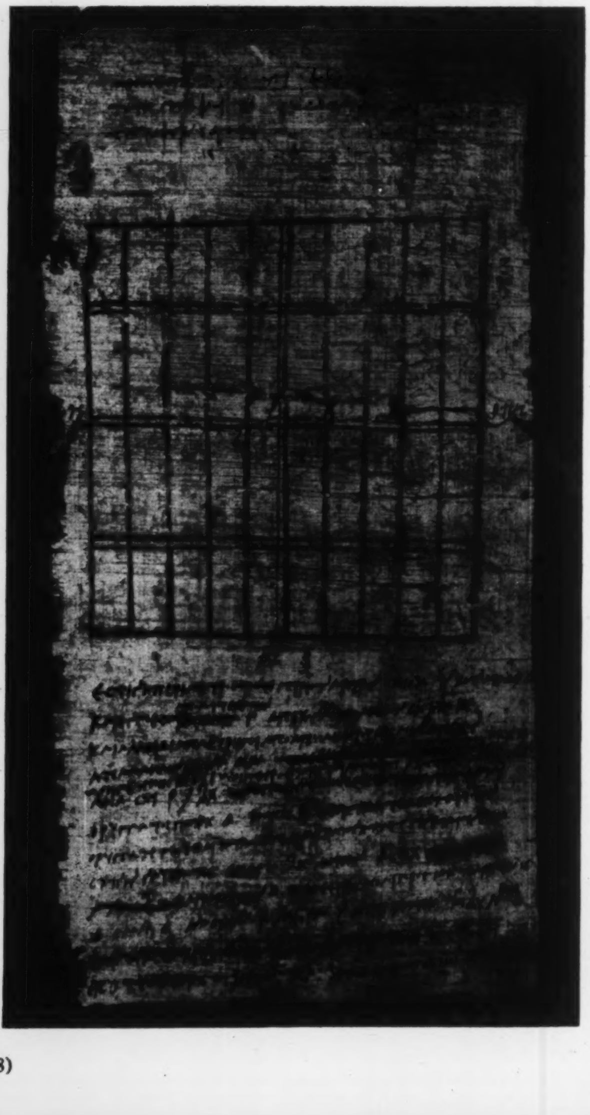
The authorization includes 12 irrigation projects in addition to the four main storage units. Four are in Wyoming, two in Utah, one in New Mexico, and five in Colorado. Water will be provided to irrigate more than 130,000 acres of land now dry and supplemental water to about 230,000 acres of land now irrigated.

The Engineer through the Ages

The Greek Architekton - Part 3

J. K. FINCH, M. ASCE

Dean Emeritus and Renwick Professor of Civil Engineering, Columbia University, New York, N. Y.

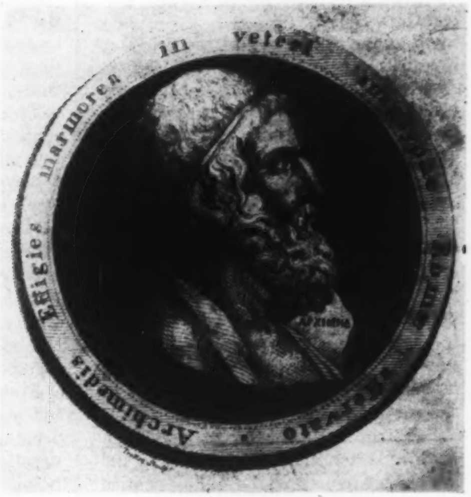


Probably oldest engineering drawing known is Greek plan of a rectangular ditching system. On an old Egyptian papyrus, preserved at University of Lille, France, it dates from about 250 B.C. Courtesy of Professor Jouguet, University of Lille.

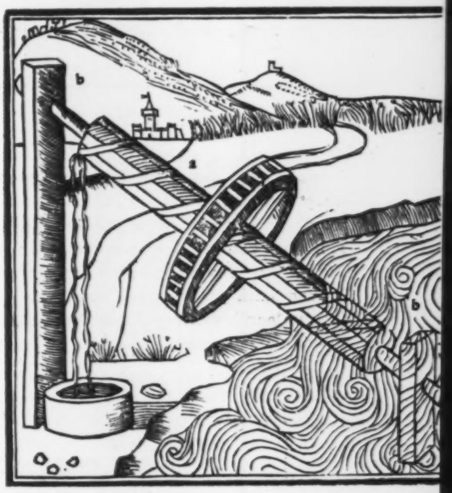
In his monumental work on Agricola, one of the greatest books on engineering, Ex-President Hoover, himself a mining engineer, remarks:

"The silver mines of Mt. Laurion formed the economic mainstay of Athens for the three centuries during which that state had the ascendency in Greece, and there can be no doubt that the dominance of Athens and its position as a sea power were directly due to the reserves from the mines." (See the translation of Agricola's *De re metallica* of 1556, by ex-President and Mrs. Herbert Hoover, London, 1912, footnote pp. 27-29.)

As early as 500 B.C., he notes, mining royalties began to appear in the Athenian budget and by 484 B.C. had developed to such an extent that they returned 100 talents to the Treasury and supplied the funds for building the Greek fleet which won at Salamis. The work of Pericles in rebuilding the Acropolis is said to have cost some 2½ million dollars, "a sum far exceeding any such public outlay ever heard of among the Greeks," and there seems little doubt that these mines provided at least an economic backlog for such activities. Xenophon recorded that "Nicias, the son of Nicerotus, kept a thousand men employed in the silver mines."



Archimedes may have looked like this traditional portrait of him from title page of a Latin edition of his works published by Clarendon Press, Oxford, 1792. His screw pump (below) was used in unwatering excavations even in late eighteenth century. Water wheel in center of device turns axial screw enclosed in a pipe. From first illustrated edition of Vitruvius, 1511.



Engineering-wise the mines of Laurion appear to mark, as so many other Greek works did, a notable step forward in daring and technique. Early copper mining operations by the Egyptians on the Sinai Peninsula were limited to surface workings or, at the most, followed outcrops of ore for modest distances underground. Of the mining of iron by the Hittites we know little. Herodotus says he saw the mines of Thrace (in the Balkan area) which were early worked by the Phoenicians who, he says, "turned a high mountain upside down in search for ores." But at Laurion, and as far as we know for the first time in mining history, the Greek miner boldly sank shafts through "country rock" to reach hidden ore bodies deep below.

The Laurion deposits are silver-lead "lenses" of irregular size and shape occurring along the "contact" between almost horizontal beds of limestone and slate. The upper ore bodies could, to be sure, be worked from the surface and gave a hint of what might be below, but the lowest and richest of the three contacts could be reached only by sinking shafts. Such shafts, ordinarily 4 to 6 ft square, were sunk to depths of as much as 380 ft. In some cases long inclines were dug for easier access, while drifts, often parallel and with cross cuts between, explored every corner of the area. Fortunately the mines were practically dry. Both supporting pillars, some 30 ft high, timbering, and artificial supports were used to hold the roof. Here we see the birth of mining techniques that have persisted through the centuries.

The rock was probably cut by hand chisels or picks but the "fire-setting" method—dashing cold water on a heated rock surface, causing it to crack—cannot be ruled out in many early workings. It is first spoken of by Agatharchides, a Greek geographer of the second century B.C., who is quoted as describing its use in gold mines in Egypt, Arabia, and Ethiopia, where the slave miners were said to have suffered terribly from the heat and smoke. It is described by Agricola, and is said to have been used in German mines as late as 1867. It was a useful practice until the advent of gunpowder—first employed in mining in 1613.

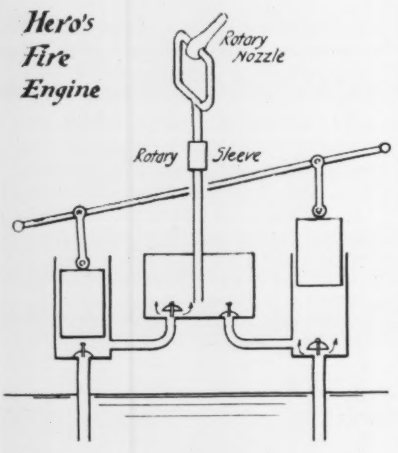
Spartan invasions interfered with the operation of the Laurion mines, and by 355 B.C. exploitation fell to a low ebb, to rise again about 300 B.C. Later these mines were worked only fitfully. A French company had some success after 1860, and many of the mines of the ancients have in recent times been rediscovered and successfully redeveloped to become, if not mainstays, at least important factors in the modern economy of the area.

Kleon, Royal Engineer of the Fayoum

Alexander's conquests threw open vast areas for exploitation by the Macedonians and Greeks. This opportunity they were quick to grasp and prepared to exploit to the utmost because of their previously developed industrial-technical skills and superior abilities in business organization. Bankers made loans and collected interest, and experts provided outstanding planning and direction in many technical fields. Aristotle writes of price fixing; the term "monopoly" was invented by the Greeks.

After Alexander's early death (323 B.C.) his vast empire was divided among his generals. Egypt came under the rule of Ptolemy, who gave his name to a line of rulers the first members of which had a high appreciation of learning combined with a keen business sense. Among their business ventures was the exploitation of the Fayoum through reclamation and colonization, a project that is of special engineering interest.

West of the Nile some 60 miles above Cairo, there is a break in the highlands that forms a large depressed area, the Fayoum, which is in part flooded by Lake Moeris. Herodotus, although he found Egyptian irrigation works in general too unimpressive for mention, apparently thought that the Fayoum was irrigated by man-made works and marveled at the result. It was undoubtedly a populous area of ancient Egypt. An early canal may have brought water from the Nile but there is no support for assuming any outstanding early irrigation works, and by the fourth century A.D. the Fayoum had reverted to desert. Its engineering interest stems largely from the fact that it was exploited by the Greeks, and that there are numerous papyri from this period which, preserved by the dry climate, have survived and are still being unearthed, to find their



Force pump, described by Hero, probably was invented by Ctsebius and used by Romans as a fire engine. In sixteenth century it was introduced into Europe for this purpose and continued in use until steam type was invented in nineteenth century. From Woodcroft's "Hero's Pneumatics," London, 1851.

way into the libraries and museums of the world. Among these manuscripts are numerous accounts and contracts of one Kleon, Royal Engineer or Commissioner of Public Works of this *nome* (or province of ancient Egypt) and his assistant and successor, Theodorus. Both were active about 250 B.C., and their records reveal many details of early construction practice and methods.

Apparently a canal had been built from the Nile large enough to bring boatloads of brick, stone and other supplies into the area. Kleon, constantly referred to as an *architekton,* was responsible for such structures as the canal and also for the erection and repair of buildings. He was meticulous in keeping his records like his modern professional confreres, and faced labor and other troubles which also have a modern flavor. While canal construction and maintenance were apparently carried out by the corvée method of drafted labor, or even as a means of working off taxes, some construction was let by contract. A large number of letters deal with labor matters. Others have to do with cutting and transporting brush, which was used for protecting canal banks from scour in the form of fascines and mattresses, the latter secured by networks of ropes attached to stout pegs driven into the bank—a modern technique. Puddled clay was used to render embankments watertight, while stop-logs closed sluice openings.

Other documents reveal the contract practices of the day. Specific clauses deal with the items of work to be performed, and provision is also made for partial payments as the work progressed. It is especially interesting to note that iron tools were scarce. The contractor acted chiefly as a master of labor, and spades were provided for his men, since it is recorded:

"A sufficient number of spades shall be supplied from the royal storehouse, the price of which shall not be added to the account, and which he shall return, on the completion of the work, having the same weight as when he received them."

Such contracts appear to have been let by "Dutch auction", that is, to the lowest bidder. "Issue a public notice and advertise, if any wish to contract at a lower tender, to send word to Kleon, the architekton."

Naturally few engineering plans have survived from ancient times. Most of those which have been found are diagrams rather than scale drawings, and dimensioning is rare. There are a number of sketches of Egyptian buildings including a scale drawing of a pylon gateway, but the first "engineering" plan we know of comes from the papyrus treasures of the Fayoum. It shows a rectangular system of ditching and gives all the sizes, lengths, and volumes to be removed in the work on a large estate of over 6,000 acres and involving over 50 miles of ditches and embankments.

About 253 B.C., Kleon retired leaving his responsibilities to his assistant. Years later, in the second century B.C., negligent administration and maintenance led to decay, the desert began to reclaim its own, and there is little material evidence left today to mark the labors of Kleon, the *architekton.*

Archimedes and Hero, *mechanikoi*

Our knowledge of the Greek grasp of mechanics rests on solid ground. Parts at least of the works of a number of Greek "mechanicians" have come down to us, notably those of two outstanding workers in this field, Archimedes and Hero. The major question involved is not "What was known?" but "To what extent did such knowledge find useful application in the engineering practice of the day?"

It is clear that knowledge becomes power only through use. Progress in engineering is measured not by what might be, but by what actually is accomplished. History clearly demonstrates that the application and use of knowledge have often proved more difficult than the discovery of the underlying theory. It cannot be assumed that the mechanics of Archimedes or the many ingenious devices of Hero truly reflect either the technical practices or the actual products of their times.

These two *mechanikoi* are in sharp contrast. Archimedes glorified the theoretical, purely scientific approach but achieved his fame through spectacular applications of his knowledge, of which he has left us no record. Hero, on the other hand, had the clever, ingenious and inventive mind of the engineer. He aimed to bridge the gap between theory and practice, to wed scientific truth to purely empirical understanding springing from actual practice.

Much of Hero's work undoubtedly reflected earlier advances, although some of his shrewd suggestions are unquestionably his own. Others may well be visions of what he thought might be. Both men came late in Greek history. Archimedes lived 287-212 B.C., in the declining years of Greek independence, and Hero has been placed anywhere from 100 B.C. to 200 A.D.

Archimedes spent most of his life in that more or less independent Greek outpost of civilization, Syracuse, in Sicily. He achieved great popular acclaim as the designer of special naval and military machines for King Hiero of Syracuse. Among these inventions was the screw pump, known as the Archimedean screw, later widely used in unwatering excavations and so employed by Perronet, the French bridge expert, in the late eighteenth century. A German writer has dubbed Archimedes "the technical Yankee of antiquity." Plutarch describes many of his pulleys, capstans, catapults, and other devices, yet observes:

"He possessed so high a spirit, so profound a soul, and such treasures of highly scientific knowledge, that though these inventions had now obtained him the renown of more than human sagacity, he yet would not deign to leave behind him any commentary or writing on such subjects."

The known books of Archimedes are his outstanding mathematical studies of solids and sections. He also discussed the law of the lever and is credited with the statement that, given a place to stand, he could move the world—recalled in the seal of the American Society of Mechanical Engineers. His ideas on centers of gravity and equilibrium gave more precise meaning to many facts long used in the work of the *architektoni.*

Vitruvius amusingly describes the famous story of Hiero's crown in which the measurement of weight and displacement in water uncovered a theft. The idea of displacement, he says, was revealed to Archimedes when he went to the bath and "observed that the more his body sank into the tub, the more water ran out of it." Indeed the method of Archimedes was that of observation and deduction—what is called the scientific method today, but has always been a major source of technical advance. He wrote, "Certain things first become clear to me by a mechanical method, although they have to be demonstrated by geometry afterward because their investigation by said method does not furnish an actual demonstration."

Of Hero's work, seven of some supposed twelve books survive. He gives practical applications of earlier knowledge, adds some keen deductions of his own, and describes a number of curious, apparently original mechanical devices and toys. He shows he was familiar with the lever, wedge, screw, and wheel and with gears and worm gearings, with cylinders, pistons and valves, and he applied them most ingeniously to apparatus of various kinds. He deals with machines of war—the catapults and stone-throwing military equipment of ancient times that persisted down to the age of gunpowder and gave the engineer his name. (Such a device was referred to by a late Roman writer, Tertullian, about 200 A.D. as a product of genius, or *ingenium*, from which the modern title engineer is derived.)

Hero also describes devices for raising weights with derricks and presses. He discusses stereotomy (the geometry of stone cutting) and the measurement of areas and volumes. His treatise on surveying covers not only tunnel surveying and shaft plumbing as previously noted but also describes his *dioptra*, which, although purely a right-angle device, was the forerunner of the modern surveyor's transit. This he equipped with a water-level sighting attachment, and he explains its use with target leveling poles in running levels by subtracting minus from plus sights as we do today.

Hero's *Pneumatica* includes his well-known fountain, his rotary toy steam turbine, and the hand-pump fire engine which not only was used in ancient times but became the standard fire-fighting equipment throughout the civilized world and was pulled through our streets by our earlier American volunteer fire-departments.

Since he came too late in Greek history to materially affect her engineering progress, one wonders to what extent, if any, Hero influenced Roman engineering technology. It is not clear that Vitruvius knew of his work—Hero may, in fact, have post-dated him But one of Hero's major observations, that the flow of water could not be correctly measured simply by the area of the cross-section of the pipe or channel, was certainly lost to the Romans. They persisted in ignoring the effect of velocity although Hero had advised measuring the yield of a spring by diverting the flow into a basin so that the volume collected in a certain time, as recorded by sun-dial, could be ascertained.

Hero left us not one text but an encyclopedia of early engineering technology. His works reveal the remarkable technical understanding and inventiveness of the Greek mind. Yet the Romans seem to have learned what they knew from other ancient sources or other contacts. The mechanics of motion and of fluids, although discussed by Aristotle, had to await the passage of many centuries for its development.

Looking back

It is undoubtedly true that there are many links in the chain of events, yet one cannot refrain from asking: What were the elements in ancient Greek life that "spark-plugged" all these remarkable contributions to technical progress?

There are those who would ascribe these Greek advances to the restless, inquiring, ambitious character of the Greek mind as contrasted with the plodding, static, unprogressive attitude of the Orient, dulled through centuries of toil without hope. Unquestionably the Greek was quick to learn but it is also true that he was urged to progress by the spur of competition. By and large the Greeks were a nation of merchants and traders rather than, as we usually picture them, an aggregation of poets and philosophers. In spite of the limitations placed on citizenship and the presence of a large number of slaves, there was a vocal and effective body of men free to follow what Adam Smith has described as "the natural propensities of economically active men." In fact we find in ancient Greece, as noted, the beginnings of that specialization in industry to which the "Father of Modern Economies" so largely attributes the rise of the Industrial Revolution in eighteenth century Britain. The word "economics" is itself Greek—meaning the art of thrifty management. The stimulation of a far more widespread opportunity for free enterprise than the past had afforded must have exercised a vital influence on Greek life.

The modern scientist would perhaps attribute the technical progress of the Greeks to the advances they made in the pure or abstract sciences. Undoubtedly some of their contributions in mathematics found application in the work of the *architekton*. For example, Euclid (c. 300 B.C.) in his geometry (that is, "land measurement") sought proofs for relationships discovered through experience and observation by earlier workers but also added new knowledge some of which was undoubtedly applicable to the problems of the day. In mechanics Archimedes discovered the law of the lever, a device which similarly had been known and used for at least thirty centuries. While his and other discoveries marked the birth of the science of mechanics, which is basic in modern engineering practice, it seems impossible to uncover notable practical applications in Greek works. It is only within the last century that mechanics has found any extensive useful application in engineering.

Similarly it is only within the same period that the discoveries in physics and chemistry have "triggered off" the development of new methods and products in engineering and industry. All the great earlier inventions—the arch, the truss, the steam engine, and even the aeroplane, predated their scientific study and analysis. The major role of science in engineering has, in fact, been in the scientific rationalization of earlier practices and operations stemming from first-hand experience and observation—the replacement of purely empirical, *qualitative* judgments by more fully *quantitative* mathematical conclusions. This replacement took man over two thousand years—measured from the heyday of Greek culture—to effectively realize.

Progressive as the Greeks were in many fields, they unhappily never solved their governmental problems. Plato's idealistic speculations were tried in the Greek colony in Sicily but brought only disaster. The decline of ancient Greek civilization was due primarily to the inability of the Greek city-states to join together as a nation and defend their culture. Yet whatever the ups and downs of their political and military fortune, the material accomplishments of a people are never lost. Greece, as we have noted, built on and greatly extended the teachings of the past. The next great nation to assume leadership was Rome, who found the tools for much of her remarkable engineering accomplishment in her inheritance from Greece.

The remarkable contributions of the Romans however were primarily practical in nature for, unlike the Greeks, they had little interest in scientific theory. Thus the development of engineering science, born in Greece, was held up for centuries before men's minds again turned toward this search which has so markedly increased the power and scope of the engineer's activities in our own times.

(In subsequent articles Dean Finch will discuss our Roman engineering forerunners.)

Earth mover dumps load of clay soil that makes up embankment of AASHO Test Road loops. Scooped from three borrow pits at northern Illinois project site, this type A-6 soil was placed on grade in 6-in. uncompacted lifts.

Team of rotary speed mixers moves along a Test Road loop. These machines pulverized and blended soil while adding proper amount of water. Technician at left signals a mixer operator to change water flow on his machine.

EMBANKMENT CONSTRUCTION CONTROL

How can more than six miles of four-lane divided highway be built so as to make sure that the embankment soil under it will be almost perfectly uniform in density and moisture? That was the question facing engineers on the AASHO Road Test project in Ottawa, Ill. [See article by Fred Burggraf and W. B. McKendrick, Jr., Members ASCE, in Civil Engineering for Dec. 1956, p. 37] It was answered by instituting controls more rigid than had ever before been used in large-scale highway construction.

The necessity for uniformity stems directly from the objective of the test—study of the behavior of pavement structures of known thickness under dynamic loads of known magnitude and frequency. Thus the soil under the pavement structures cannot be as variable if differences in pavement behavior are to be correlated directly with thickness and type.

Construction of the test road, sponsored by the American Association of State Highway Officials, began in the late summer of 1956. The project is being administered by the Highway Research Board of the National Academy of Sciences—National Research Council. Heading the Board's staff at the site is Project Director W. B. McKendrick, Jr., M. ASCE, a former chief engineer of the Delaware State Highway Department. Actual construction of the test road is being supervised by the Illinois Division of Highways under the direction of W. E. Chastain, Sr., engineer of physical research for Illinois.

The contract for the grading operations was awarded in July jointly to S. J. Groves & Sons and Arcole Midwest Corporation, at their bid of $2,025,000. Work began in late August and was more than 95 percent completed when weather brought operations to a halt in mid-November. During that period more than 1¼ million cu yd of earth were placed in embankment under extremely strict controls.

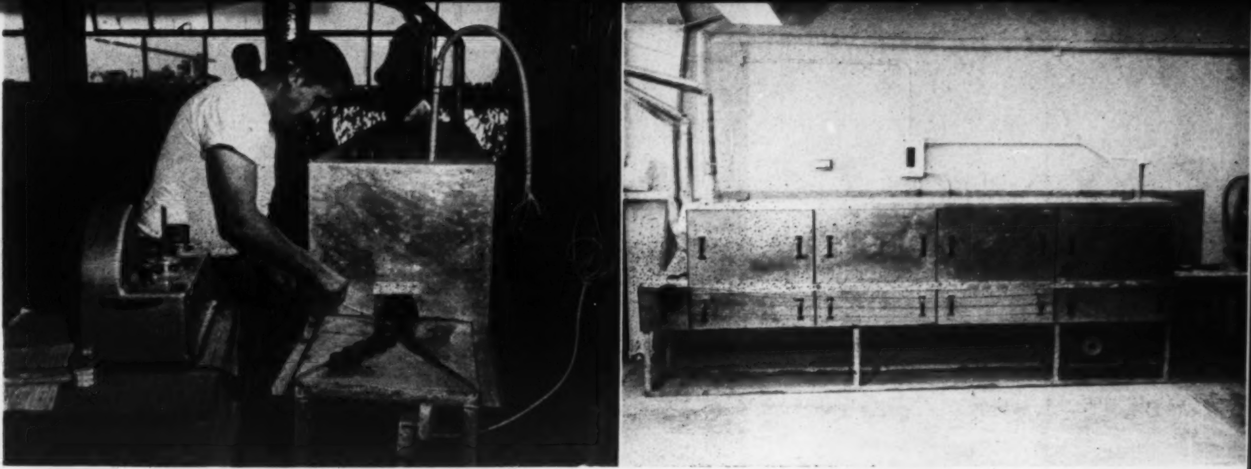
Fast test schedule

To secure the desired uniformity, the road test staff set up a testing program that, because of its magnitude, necessitated the designing and building of special equipment to keep pace with the fast-moving construction machinery. The contractors placed on the job 225 pieces of equipment, valued at more than $5,000,000. Grading operations went on simultaneously on the four main loops of the test road. Earth movers of 18-cu yd capacity scooped the clay, type A-6 soil, from three borrow pits and placed it on the test-loop tangents in 6-in. loose lifts, which were leveled with blade graders.

At that point the soil was tested for moisture content and a decision made on the amount of water to be added before compaction. The lift was then processed with teams of rotary speed mixers that pulverized and blended the soil, and added water in the amount needed. Compaction to a lift thickness of 4 in. was done with pneumatic-tire rollers loaded only to 15 tons, which operated in a rigidly controlled pattern across the embankment to ensure uniform compaction.

The lifts were placed in construction blocks 500 to 800 ft long, with transition areas 70 to 100 ft long between them. All turning and crossing over of equipment was confined to these transition areas. Because of the irregular operation of the equipment, compaction of the soil in these transition areas is different from that in the test sections within the construction blocks. Thus the transitions will not be considered in the test.

Once a block lift had been placed and compacted, the testing procedure began in earnest. The specifications called for a compacted density of 95 to 100 percent of standard maximum (AASHO T-99) and the control of moisture content between plus or minus 2 percent of optimum. Engineers had 90 min from the completion of rolling to make the necessary tests, analyze the data, and decide to accept or reject the block lift. This involved taking at least five samples for 1-point



Soil samples emerge from drying oven every 30 sec (view above, left) at peak operation of this equipment, designed by AASHO Road Test staff. Utilizing endless chain and infra-red lamps, oven required only 23 min to dry a sample, thus enabling extensive testing program to keep pace with fast-moving construction machinery. Oven is seen from side in view above, right. This high-speed drying oven has been described as "backbone" of testing program.

ON AASHO ROAD TEST

W. N. CAREY, JR., A.M. ASCE
Chief Engineer for Research, AASHO Road Test, Ottawa, Ill.

wet Proctor tests, determination in the laboratory of maximum densities and optimum moistures, field sampling and laboratory testing of 20 field density specimens, and all computations and statistical analyses.

To do all that in 90 min required the use of a two-way radio system to dispatch trucks to pick up samples in the field and to report test results back to the field. It also required the modification of a device to obtain the field density samples, and the designing and building of a high-speed drying oven for moisture content determination.

The device for taking field density samples is a modified Shelby tube sampler using a drop-hammer on a shaft to drive the tube into the compacted soil. The resulting core in the tube was wrapped in aluminum foil, picked up by a radio-dispatched truck, and taken to the laboratory.

The high-speed drying oven has been described as the "backbone" of the testing program. Whereas standard drying procedures require several hours for drying of a soil sample, the staff-designed oven at the AASHO Road Test dried a sample in 23 minutes, in a continuous process which was capable of turning out three samples each minute. It employs infra-red lamps under which samples are carried on an endless chain.

During the construction period, from late August to mid-November, all types of tests totaled more than 51,000, with a daily average of about 850. In one 13-hour working day, the laboratory completed 1,200 tests. A total of 6,800 compaction tests, almost 17,000 density tests, 27,000 moisture-content tests, 250 plate bearing tests, and almost 80 California Bearing Ratio tests were made.

A large staff was of course required to carry on the construction control and the laboratory work. At the peak of operations, 59 engineers and subprofessional people worked on construction control. The Road Engineer had two assistants—one in the office, one in the field. Each loop had a resident engineer, a survey party under the leadership of an engineer, and several technicians to assist in inspection.

The materials laboratory was staffed with 55 engineers and subprofessional people at the height of operations. Thirty worked in the laboratory processing soil samples, and a testing crew of five, under the supervision of an engineer, collected samples in each loop.

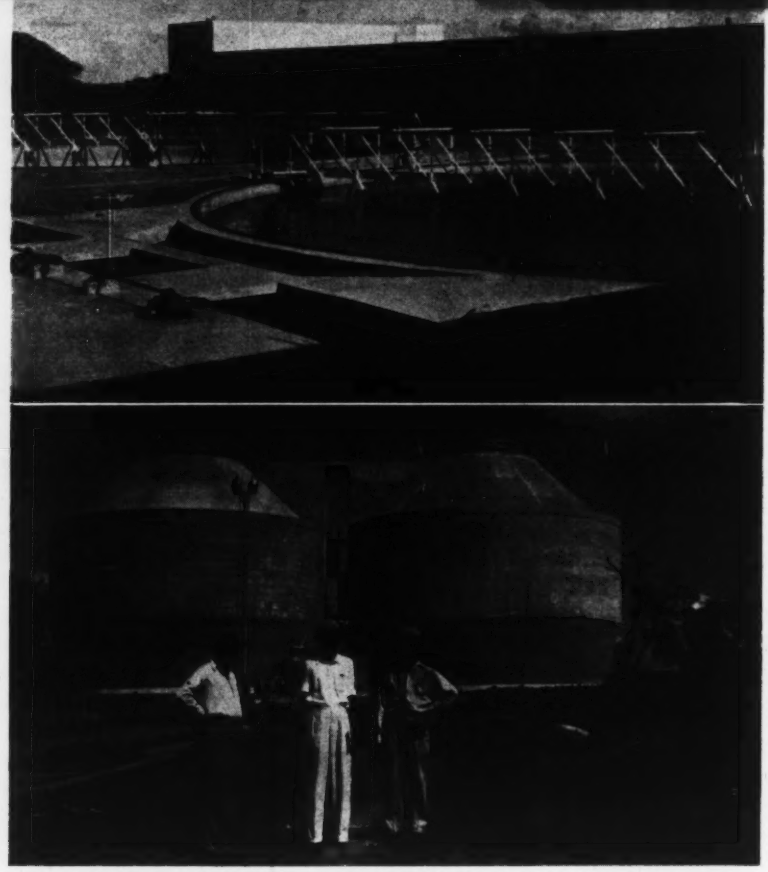
Successful control program

The success of the control and testing program is evident from the fact that only a few block lifts had to be rejected and reworked. With field density samples taken from random locations in each block lift, each square foot had an opportunity to be sampled. Thus, a valid estimate of the distribution of field densities could be made from a relatively small number of samples.

Final figures on the entire embankment showed that the average compaction control was better than had been considered possible. Only 8 percent of the estimated distribution fell below 95 percent of maximum density, and only 14 precent fell above 100 percent. The overall mean percentage of compaction was 97.9, and the mean standard deviation was 1.71 percent. The mean range of actual density values by block lifts was 6 lb per cu ft from the lowest to the highest observed values.

When construction was resumed in the spring of 1957, the contractor reprocessed and recompacted the upper layer of the embankment, bringing it again to the specified plus or minus 2 percent of optimum moisture and to between 95 and 100 percent of maximum density. The project engineers feel that this will satisfy the requirements for an embankment that will be as nearly uniform as possible under all test sections of the AASHO Road Test.

When the test traffic starts its two-year-long trip over the loops this fall, the behavior of the pavement can be correlated with thickness and type.



Capital city of New Delhi has some excellent examples of modern water and sewage treatment facilities. Recent additions include circular settling tanks and rapid-sand filter house for water treatment works, in top view, and sludge digestion vaults for sewage treatment plant, directly above.

INDIA__

a challenge to the sanitary engineer

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Until the British introduced some public health measures about 200 years ago, the population of India had remained relatively stagnant for centuries, checked by famine and pestilence, with a life expectancy of less than 20 years. With the population doubling every 75 years in the past two centuries, India today counts some 375 million souls, and the life expectancy is about 33 years.

With modern transportation and agricultural methods, famine is fast disappearing as a population control. Public health development is lagging far behind food production in lengthening the life span, but it too is making rapid progress under new national sanitation programs, aided by United Nations agencies and other foreign aid. With all these improvements tending to increase the population, there comes the impelling need for population planning, but this takes us outside our present subject.

To get some idea of the public health problem in India and other countries of southeast Asia, I quote from Vincent B. Lamoureux, of the Public Health Division of the International Cooperation Administration (formerly Point IV), in ASCE *Proceedings* (Vol. 82, SA 1, Paper 885, Feb. 1956):

> "Disease is rampant and many of these diseases are those all-susceptible to control by proper environmental sanitation and sanitary engineering activities. Respiratory infections, eye infections, the diarrheas and dysenteries, and many of the parasitical diseases may be controlled and even eliminated by proper sanitary measures. Malaria is prevalent in all these countries. Schistosomiasis extends along the north shore of Africa through the Middle East into Iran. Diarrhea and dysentery are common. Trachoma and conjunctivitis are serious in many of these countries. Add to these hookworm, guinea worm, filariasis and other parasitical diseases, and the load of illness and disability carried by the populations becomes enormous."

What is India's view of the situation? *India 1955*, a reference annual published by the Government of India (New Delhi), puts it succinctly:

> "Only 6 percent of the total number of towns in India have a system of protected water supply serving 6.15 percent of the total population and 48.5 percent of the urban population. The position of the water supply in rural areas and in small urban areas is much worse. Nor is sanitation in any way better. Of the 73 cities with a population of over 100,000 each, only 23 have sewerage systems. Twelve of these towns are partially provided with sewerage. Thus, only about 3 percent of the total population is served by sewerage systems."

Urban and rural water supplies

About half the urban population receives some type of protected water supply. This may range from individually owned and operated wells to a comprehensive modern treatment and distribution system such as that of New Delhi. Calcutta has a dual system of surface water supply, with a filtered supply of about 96 mgd and a supply of unfiltered water from the River Hooghly of about 108 mgd running in separate mains. (Figures are in U.S. gallons throughout.) This is India's largest city, with a population now estimated at 5 million, the second largest city in the Commonwealth (next to London). Its filtered water supply also comes from the River Hooghly, about 17 miles upstream from the center of the city, where about three-quarters of it is subjected to slow sand filtration and the remainder to rapid sand filtration. The filtered water is chlorinated to 0.15 ppm residual and pumped to the city in a 60-in. steel main and two smaller cast-iron mains.

The steel main, which carries two-thirds of the filtered water, was laid in 1923-1926 and is now severely corroded, with bad leaks at several points. Much of the day the pressure is only enough to keep the mains filled. There are 591 miles of mains and approximately 84,000 connections for the distribution of filtered water, while for unfiltered water there are 441 miles of mains and 58,000 connections. On a per capita basis, the density of potable water connections is about one-twelfth that of an American city such as Los Angeles.

The unfiltered supply is supposed to be restricted to street-cleaning, fire-fighting and similar uses. In the hot months, however, the acute shortage of filtered water drives the populace in some areas to the use of unfiltered water for cooking and drinking. These areas are the focal points of the epidemics of cholera and other gastro-intestinal diseases that visit the city with unfailing regularity every spring.

Throughout the Calcutta area the surface water supply is augmented by more than 50 drilled wells, or tubewells as they are called. The ground water from this region is extremely hard and often brackish owing to the intrusion of salt water from tides in the Hooghly estuary. In the Howrah area, near Calcutta, chloride content sometimes reaches 700 ppm.

The cost of supplying and distributing filtered water to Calcutta comes to about $35.50 per acre-ft. The water from tubewells needs softening, for which two small plants now in operation near Calcutta use the lime soda ash process at a softening cost of about $32.20 per acre-ft, four times the cost of softening at the Weymouth Filtration Plant of the Metropolitan Water District of Southern California. The cost of supplying the unfiltered water is about $9.00 per acre-ft, or about the same as that of the District's untreated water.

In the Second Five Year Plan period, the Corporation of Calcutta plans to augment the supply and distribution of filtered river water from 100 to 180 mgd, to increase ground-water supplies to 196 mgd, and to abandon the unfiltered system, thereby making available to all parts of the city a potable supply of about 75 gal per capita per day. The total cost of the proposed plan, including the laying of a new 60-in. trunk main from the filtration works, additional pumping equipment, and development of new tubewells, is estimated at $25 million.

But the chief concern of the sanitary engineer will be for that half of the urban population and almost the whole of the rural population now without any protected supply. These unfortunates have traditionally derived their water largely from tanks or ponds or open wells. In the spring, the hottest part of the year just before the monsoon rains, tanks and wells frequently dry up, working great hardship on the villagers and of course decreasing the dilution factor for polluted waters.

The United States has been active in aiding the development of new tubewells, having committed some $20 million of Technical Cooperation funds to a program of drilling 2,650 wells. These are however principally for irrigation in the northern plains, enabling the farmers to grow two crops a year instead of one. Public advisers from the World Health Organization and the ICA have done much to improve exist-

Indian housewife's habit of cleaning brassware with cinders results in grit load of some 2,000 cu ft per day at Delhi sewage treatment plant. Grit removal will soon be mechanized but present method is shown at top left. As shown in photo below, manual cleaning is also required in desilting basins of water treatment works. This is frequently necessary because of heavy silt load of River Yamuna, source of the supply. Frequently, however, no such facilities as these are available. Typical city of 500,000 utilizes open drain (at left in view next below) and night-soil collection as principal sewage disposal method. In bottom view, coolie labor lays vitrified clay sewer pipe, two out of every three joints being made above ground where working conditions are easier.

ing open wells by capping them and installing water-lifting equipment—often a version of the ancient Persian wheel.

The sanitation problem

A good example of the many cities that are largely unsewered is Howrah, with a half million population. Liquid wastes are carried, mostly in open drains, to the River Hooghly which is also the source of Calcutta's unfiltered water supply. Night soil is collected from the home latrines and taken to collection depots for utilization in a "conservancy system," in which it is buried by trenching and covering with about 12 in. of soil, and sometimes composted with other refuse to make fertilizer.

In both Howrah and Calcutta the bustee or slum areas are among the world's worst. It is estimated that more than a third of Calcutta's five million people live in unsewered areas. The situation is greatly complicated by the arrival of refugees from East Pakistan, who have been entering Calcutta at the rate of 30,000 to 50,000 per month for the past nine years. Great numbers of them remain in or close to the city, living in makeshift huts or simply on the streets and in the parks. Public sanitary facilities for them are totally inadequate. Here indeed is a challenge for the sanitary engineer.

Modern sanitary works

Fortunately India has within her boundaries some excellent examples of both water and sewage treatment facilities. The capital city of New Delhi will serve as an example of what one day may come for all of India's urban communities. Delhi (comprising both the old and the new cities) draws its water from the River Yamuna, highly laden with silt. The primary tanks in which this water settles require frequent manual cleaning. Further settling tanks are both rectangular and circular, although circular tanks are replacing the old rectangular ones, constructed with rib-and-port sections dividing the basins into approximate squares. Rapid sand filtration and chlorination finish the treatment.

At the other end of the city lies the modern sewage treatment plant with a capacity of 43 mgd, half of which is subjected to the activated-sludge process and 7 mgd to bio-filter secondary treatment, the remainder being discharged after primary treatment for irrigation. The initial grit chambers are one of the key features of the plant, collecting some 2,000 cu ft of grit per day, which requires daily changeover and manual cleaning. The high grit load is caused by the housewife's traditional use of cinders and sand for abrasive cleaning of brass cooking and eating utensils—a local problem similar to our detergent foaming.

The Delhi treatment plant also includes square primary settling tanks of the Dortmund type, two huge vertical digestion chambers, new circular bio-filters, and circular and rectangular final settling tanks. As in this Delhi plant, the trend in India is toward filtration—especially high-rate or bio-filters—instead of activated sludge plants. The general experience seems to be that the activated-sludge process is sensitive and difficult to control.

A helping hand

Aside from its technical cooperation assistance in the tubewell program mentioned earlier, the United States has made an impressive contribution to the malaria control program, having supplied 5,000 tons of DDT before mid 1954. An estimated 75 million persons had been suffering from malaria each year, with an annual mortality of 1 to 1½ million. This number is now a fraction of its former value, and the end of the malaria menace is anticipated within 10 years. Another control program, that of filariasis, was started in 1955. An estimated 25 million persons are afflicted with this parasitic disease, carried by a mosquito other than the malaria-carrying anopheline.

In these programs the United States is supplying only materials and a few supervisory personnel: a sanitary engineering adviser to the Ministry of Health, who is also the Chief Sanitary Engineer of the Health and Sanitation Staff; a program engineer whose primary responsibility has been to get into operation the huge five-year $200 million National Water Supply and Sanitation project; a professor of sanitary engineering assigned to the All-India Institute of Hygiene and Public Health in Calcutta; an impounded-water and malaria-control engineer; and a sanitarian assigned to community development activity.

The international organizations, such as World Health Organization, United Nations Children's Fund and Colombo Plan are also engaged in various aspects of the program. Task groups such as this get right down to brass tacks. Whatever the political successes or reverses of the United Nations, we should never lose sight of the effective work of its task groups in raising living standards in the less fortunate countries.

India's part in the work

The most common criticism of the U. S. Technical Cooperation Mission from uninformed sources is that we are supplying all the money and most of the personnel, and that India is just sitting back taking it all in. Nothing could be further from the truth. Consider, for example, Operating Agreement No. 25 of the Technical Cooperation Mission on the National Water Supply and Sanitation program. Our total commitment to June 30, 1954, was $3,100,000, while India's share was some $22,000,000, more than seven times ours.

The job facing the sanitary engineer in India is tremendous as this nation, with a population 2¼ times that of the United States, pulls itself overnight from Biblical times into the twentieth century. Public health engineers agree that the basic obstacle is the shortage of trained manpower, since there are in all India less than 25 sanitary engineers! It is as if all but a half dozen of our sewage and water treatment works were devastated by an attack from Mars, and 11 men were sent out to serve the sanitary engineering needs of the entire United States. To this difficulty must be added the natural reluctance of a people to change the ways of centuries. But the power of ferment in Asia today should never be underestimated. Its peoples have caught a glimpse of a better way of life and they are determined to have it.

China and India are the world's two most populous countries, both striving mightily to cast off the lethargy of centuries and bring to their peoples the advantages of the twentieth century. These two nations have chosen widely divergent paths, China the way of Communism, and India the way of parliamentary democracy. Uncommitted nations the world over are watching these two for evidences of progress. As India forges ahead in her programs of sanitation and water supply, we can take pride in the influence we are extending, far beyond the Technical Cooperation Mission or other agencies.

One of the ranking sanitary engineers in India and chairman of the sanitary engineering division of the Institute of Engineers (India) has a doctorate from the University of Iowa and is a member of ASCE. I was fortunate enough to introduce him to the work of the California State Water Pollution Control Board, and he has requested and received all its publications. Many are being reprinted in part as guides for similar work all over India. Such is our long-term cooperation with a fellow democracy. This is as it should be, for we are all in this thing together as the world grows smaller and smaller. India is a challenge to all sanitary engineers who recognize their citizenship in the world community.

The writer extends his sincerest thanks to Mr. P. C. Bose, Chief Engineer, Directorate of Health Services, West Bengal, for his observations and information about the Calcutta water supply, and to Dr. B. V. Bhoota, M. ASCE, Public Health Engineer of Bombay, for his views and information about sewage treatment plants.

Fine screen designed for river water

MAX SUTER, M. ASCE, Head, Engineering Research, State Water Survey Division, Urbana, Ill.

At its Peoria Laboratory, the Illinois State Water Survey is carrying out a research project on the artificial recharge of ground water. (See the writer's Paper No. 1102, Journal of the Irrigation and Drainage Division, Proceedings of ASCE.) Water used in the recharge operation is taken from the Illinois River and treated with chlorine before it enters the two pits operated in connection with the project. Because it is river water, it must be screened in some way to remove leaves, grass, fish, and similar debris.

Pit No. 1, which has been operated for five seasons, is fed by gravity and therefore the flow into it varies with the river stages. For this pit, a Johnson well screen was selected having a length of 27 in., an outside diameter of 12 in., and 1/8-in. slots. This screen is mounted vertically for easy cleaning, and the cleaner is a ring that fits loosely around the outside of the screen.

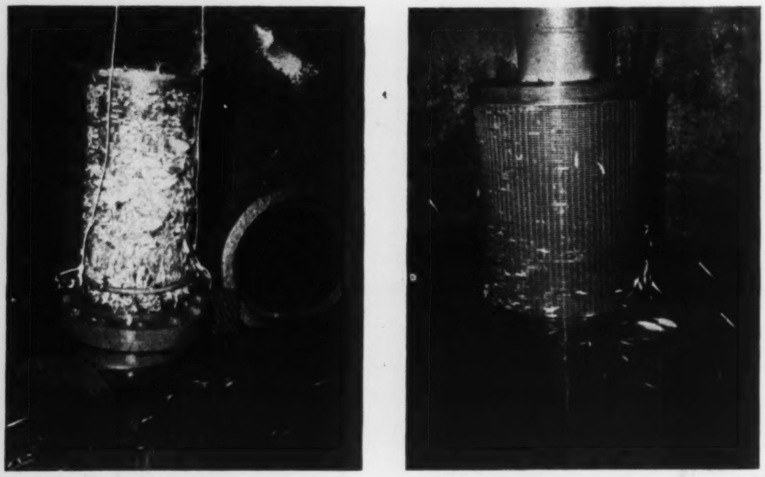
This cleaning ring is a piece of pipe 5/8 in. in inside diameter, which has fifty 1/16-in. holes spaced at equal intervals around it. When the ring is connected to a hydrant, water comes out in jets from the holes at an angle of 45 deg below the horizontal. Since the ring fits loosely on the screen, it can be moved, washing debris off the screen when the velocity of the water through the screen slots is 0.6 ft per sec (fps) or less.

After operating Pit No. 1 under varying conditions, it was found that particles of debris were tightly held to the screen whenever the velocity exceeded 0.8 fps, and that above this rate of flow the cleaning ring would not wash the debris completely from the screen. In fact there was difficulty in moving the ring up and down the screen.

As a result of this experience, when Pit No. 2 was built in 1956, these factors were taken into consideration in designing the screen for the intake to the 3-mgd pump which discharges water into this pit.

The second screen, also a Johnson well screen, is 36 in. high, 24 in. in diameter, and has 1/8-in. slots. These dimensions were selected to give a flow velocity of 0.6 fps through the 1/8-in. slots when the rate of flow is 3 mgd. The screen is cleaned by shutting down the pump and allowing the water in it to backflush the screen.

Experience so far, including a period when the river water was heavily loaded with algae, sea grass, and dead leaves, shows that the screen on the pump is easily kept clean. On the other hand, the screen to the gravity-fed pit, at a flow of 1.0 fps, clogs rapidly and requires brushing by hand to maintain maximum inflow. The accompanying photographs clearly reflect the conditions at the two screens.



Screen at Pit No. 1 (left) clogs rapidly at flow of 1.0 fps. This screen is 27 in. high, with outside diameter of 12 in. and 1/8-in. slots. Screen at Pit No. 2 (right) is 36 in. high, with diameter of 24 in. and 1/8-in. slots. Dimensions were chosen to give flow velocity of 0.6 fps through screen when rate of flow is 3 mgd. Note cleanness of this screen as compared with that for Pit No. 1.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Conference

Kresge Auditorium, Massachusetts Institute of Technology **Cambridge, Mass., August 26-28, 1957**

Co-hosts: Hydrodynamics Laboratory, Dept. of Civil and Sanitary Eng., Massachusetts Inst. of Technology; Boston Society of Civil Engineers, Hydraulics Section; Massachusetts Section, ASCE

ADVANCE INFORMATION ON ATTENDANCE

To help in planning adequate facilities for the Cambridge meeting, the Convention Committee requests early notification of plans for attendance.

It will be appreciated if those who have not already given such notification will please fill out and mail the coupon on page 133.

REGISTRATION

Kresge Auditorium Lobby, M.I.T.

4:00 to 9:00 p.m. Sunday, Aug. 25

8:30 a.m. to 4 p.m. Mon., Tues. and Wed., August 26-28.

Registration fee, $3.00 (except ladies and students).

Messages for those attending may be addressed to the Hydraulics Division Conference Committee, Room 48-205, Massachusetts Institute of Technology, Cambridge, Mass., and will be held at the Registration desk.

All times, Eastern Daylight Saving

FIRST SESSION

Monday Morning, Aug. 26

Presiding: Arthur T. Ippen, Member, Executive Committee; Frank B. Campbell, Chairman, Committee on Research; Hydraulics Division

9:30 **Welcome by**
C. Richard Soderberg, Dean of the School of Eng., Mass. Inst. of Tech.

Session on Research

9:45 **Introductory remarks**
D. R. F. Harleman, Member, Committee on Research.

9:50 **Hydraulic Characteristics of Hood Inlets for Culverts**
Fred W. Blaisdell, M. ASCE, Project Supervisor, Soil and Water Conservation Research Div., U. S. Dept. of Agriculture, St. Anthony Falls Hydraulics Lab., Minneapolis.

10:15 **Discussion from floor**

10:25 **Flow Detention Characteristics of Tanks**
R. S. Kleinschmidt, Research Engr., Div. of Eng. and Applied Physics, Harvard Univ., Cambridge, Mass.

10:50 **Discussion from floor**

11:00 **Solitary Wave Action on Submerged Objects**
Gershon Kulin, J. M. ASCE, Research Engr., Fluid Mechanics Sect., National Bur. of Standards, Washington, D. C.

11:25 **Discussion from floor**

11:35 **Motion of Discrete Bottom Sediment Particles Due to Shoaling Waves**
Peter S. Eagleson, J.M. ASCE, Asst. Prof. of Hydraulic Eng., Mass. Inst. of Tech., Cambridge, Mass.
Luis A. Peralta, J.M. ASCE, Harza Eng. Co., Chicago, Ill.
Robert G. Dean, Research Asst., Hydrodynamics Lab., Mass. Inst. of Tech., Cambridge, Mass.

12:00 **Discussion from floor**

SECOND SESSION

Monday Afternoon, Aug. 26

Presiding: Wallace M. Lansford, Chairman, Executive Committee; L. J. Hooper, Chairman, Committee on Design; Hydraulics Division

Session on Hydraulic Design

2:15 **Introductory remarks**
Donald H. Mattern, Member, Committee on Design.

2:20 **Hydraulic Butterfly Valves**
Ross L. Mahon, M. ASCE, Eng. Sales Consultant, Carmel, Calif.

2:50 **Discussion from floor**

3:00 **Some Considerations on Use of Slide Gates as Controlled for Flow of Water**
Paul F. Keim, M. ASCE, Prof. of Civil Eng., Univ. of Calif., Berkeley, Calif.

3:30 **Discussion from floor**

3:50 **Fixed Cone Dispersion Valves—Influence of Operating Requirements and Site Conditions on Design of Discharge Structures**
M. L. Dickinson, M. ASCE, Chief Hydraulic Engr.; S. M. Barnes, A.M. ASCE, Senior Engr.; R. S. Milmoe, Jr., Senior Engr.; all of the Bechtel Corporation, Los Angeles, Calif.

4:20 **Discussion from floor**

Monday Evening, Aug. 26

8:00 **p.m. Open House at M.I.T. Hydrodynamics Lab.**

Main and Vassar Streets, Cambridge

Inspection and demonstration of various teaching and research facilities. Social hour for all attending the convention and their ladies.

THIRD SESSION

Tuesday Morning, Aug. 27

Presiding: Joseph B. Tiffany, Jr. Secretary, Executive Committee; Joseph M. Caldwell, Chairman, Committee on Tidal Hydraulics; Hydraulics Division

Session on Tidal Hydraulics

9:00 **Meteorological Aspects of Storm Surge Generation**
D. Lee Harris, Meteorologist, U. S. Weather Bureau.

9:30 **Discussion from floor**

9:45 **Numerical Evaluation of Storm Surges in Narragansett Bay**
R. O. Reid, Assoc. Prof., Dept. of Oceanography, Texas A. and M. College, College Station, Tex.

10:15 **Discussion from floor**

10:30 **Hurricane Protection Planning in New England**
John B. McAleer, Chief, Hurricane Protection Unit and George E. Townsend, Hydraulic Engr., New England Div., Corps of Engineers, Dept. of the Army.

11:15 **Discussion from floor**

INSPECTION TRIP

Tuesday Afternoon, Aug. 27

1 to 5 p.m. **Boston Harbor, Boston Army Base and Charlestown Navy Yard**

SOCIAL HOUR AND DINNER

Tuesday Evening, Aug. 27

6:30 p.m., M.I.T. Faculty Club, 50 Memorial Drive, Cambridge

Presiding: Wallace M. Lansford, Chairman, Executive Committee, Hydraulics Division

Greetings from the Mass. Section, ASCE, and the Boston Society of Civil Engineers

Greetings from the Society
Mason Lockwood, President, ASCE.

Address: Dams and their Influence on some Ancient Civilizations
Gail A. Hathaway, Past President, ASCE, Eng. Consultant, International Bank for Reconstruction and Development, Washington, D. C.

FOURTH SESSION

Wednesday Morning, Aug. 28

Presiding: Carl E. Kindsvater, Member, Executive Committee; Herbert S. Reisbol, Chairman, Committee on Hydrology; R. D. Goodrich, Chairman, Committee on Floods; Hydraulics Division

Session on Hydrology and Floods

Symposium: Appraisal of Northeastern Floods of August and October 1955

9:00 **Introductory remarks**
Gordon R. Williams, M. ASCE, Member, Committee on Hydrology.

9:05 **Meteorology of the Floods**
Charles S. Gilman, Chief, Hydrometeorological Sect., U. S. Weather Bur., Washington, D. C.

9:35 **Discussion by**
H. Alden Foster, M. ASCE, Principal Assoc., Parsons, Brinckerhoff, Hall and McDonald, New York, N. Y.

10:10 **Rainfall and Runoff Relations in the Floods**
Tate Dalrymple, A.M. ASCE, Hydraulic Engr., U. S. Geological Survey, Washington, D. C.

10:30 **Discussion by**
Howard M. Turner, M. ASCE, Consulting Engr., Boston, Mass.

10:45 **Effect of the Floods on Planning and Design Criteria for Flood Control Structures**
Elliot F. Childs, M. ASCE, Chief, Hydrology and Hydraulics Sect., New England Div., Corps of Engineers, Boston, Mass.

11:15 **Discussion by**
Gail A. Hathaway, Past President, ASCE, Eng. Consultant, International Bank for Reconstruction and Development, Washington, D. C.

FIFTH SESSION

Wed. Afternoon, Aug. 28

Presiding: Harold M. Martin, Vice-Chairman, Executive Committee; Fred H. Larson, Chairman, Committee on Sedimentation; Hydraulics Division

Session on Sedimentation

1:30 **Kinds of Data Needed to Determine Yield Rates**
Ivan M. Stout, Chief Engr., State Board of Water Engineers, Austin, Tex.; Bryce Hobbs, Office, Chief of Engineers, U. S. Corps of Engineers, Washington, D. C.

1:55 **Discussion from floor**

2:05 **Estimating Yield Rates from Hydrologic Data**
Kenneth B. Schroeder, Hydraulic Engr., U. S. Bur. of Reclamation, Denver, Colo.; Thomas Maddock, Jr., Senior Scientist, Div. of Water Resources, U.S.G.S., Washington, D. C.

2:30 **Discussion from floor**

2:45 **Estimating Yield Rates from Land Use Data**
G. Robert Hall, Geologist, Soil Conservation Service, Upper Darby, Pa.

3:10 **Discussion from floor**

3:20 **Studies of Behavior of Subaqueous Dunes**
Norman H. Brooks, Asst. Prof. of Civil Engr., Calif. Inst. of Tech., Pasadena, Calif.

3:45 **Discussion from floor**

INSPECTION TRIP

Thursday, Aug. 29, All Day

General sightseeing and inspection trip to Plymouth, Cape Cod Canal, Woods Hole Oceanographic Institution. Details to be announced.

LADIES' AND CHILDREN'S PROGRAM

Registration (no charge)

4:00 to 9:00 p.m., Sunday, Aug. 25

8:30 a.m. to 4:00 p.m., Mon., Tues., and Wed., Aug. 26-28

Hostesses will be at the registration desk in the Kresge Auditorium lobby to help with registration for all the Ladies' activities and to make arrangements for baby sitters.

Monday, Aug. 26

a.m. Coffee will be served in the lobby of Kresge Auditorium. Walk-around tours of the M.I.T. campus.

12:30 **Luncheon at Endicott House**
Program and tours of the gardens.

Children: Arrangements may be made at the Registration desk in the morning for squash, softball, golf, tennis or swimming. Tour through the U.S.S. *Constitution (Old Ironsides)*

8 p.m. **Open house, Hydrodynamics Laboratory**
Refreshments will be served by the Ladies' Committee.

Tuesday, Aug. 27

a.m. **Children: trip to Science Museum**
Open for shopping or short sightseeing trips in the downtown Boston area. Suggested places: Fine Arts or Fogg Museums, Glass flowers (Harvard University), Bunker Hill, Old North Church, Paul Revere House, Faneuil Hall, State House.

1 p.m. **Boston Harbor Inspection Trip**

6:30 p.m. **Social Hour and Dinner, M.I.T. Faculty Club**
Children: Barbecue and Party, Westgate Social Hall

Wednesday, Aug. 28

10 a.m. **Women and children: historic tour by bus**
Longfellow House, Cambridge; Lexington Battle Green

12:00 **Luncheon at Hartwell Farms**

1:30 p.m. **Louisa May Alcott House, Concord Bridge and Country Store**

Dinner and evening free
List of suggested restaurants and theaters will be available.

Thursday, Aug. 29

All-day inspection trip to Plymouth, Cape Cod Canal, and Woods Hole.

COMMITTEES

Arthur T. Ippen, M.I.T., *General Convention Chairman*

Finance: Thomas R. Camp, Camp, Dresser and McKee; Paul S. Crandall, Crandall Dry Dock Engineers; Clyde W. Hubbard, Stone and Webster Eng. Corp.; Frank L. Lincoln, Fay, Spofford and Thorndike; George R. Rich, Uhl, Hall and Rich; James W. Daily, M.I.T., *Chairman.*

Entertainment: Ralph S. Archibald, Pipe Founders Sales Corp.; Harlow G. Farmer, Woods Hole Oceanographic Institution; John B. McAleer, Corps of Engineers; Byron O. McCoy, Charles T. Main, Inc.; John G. W. Thomas, Metcalf and Eddy; George L. Wey, Port of Boston Authority; Gerrit H. Toebes, M.I.T.; Gordon R. Williams, M.I.T., *Chairman.*

Registration and Technical Program: Elliot F. Childs, Corps of Engineers; Leslie J. Hooper, Worcester Polytechnic Inst.; Lincoln W. Ryder, Metcalf and Eddy; William C. Shapiro, M.I.T.; Donald R. F. Harleman, M.I.T., *Chairman.*

Publicity: Charles E. Knox, U.S.G.S.; John Mattill, M.I.T.; Robert G. Dean, M.I.T.; Peter S. Eagleson, M.I.T., *Chairman.*

Housing: James R. Cass, Jr., Fay, Spofford and Thorndike; Joseph C. Lawler, Camp, Dresser and McKee; James H. Reynolds, Jr., Hayden, Harding and Buchanan; George Bugliarello, M.I.T.; Ronald E. Nece, M.I.T., *Chairman.*

Ladies' Program: Mrs. James W. Daily, Mrs. Gordon R. Williams, Mrs. Donald R. F. Harleman, Mrs. Peter S. Eagleson, Mrs. Ronald E. Nece, Mrs. Arthur T. Ippen, *Chairman.*

HOUSING ACCOMMODATIONS

Dormitories

Housing is available for both single men and families in the M.I.T. dormitories. The dormitories, located on or close to the bank of the Charles River, are all within a ten-minute walk from the Kresge Auditorium, scene of the technical sessions.

Room rates are $3.50 per night, single and $5.00 per night for husband and wife. For children between the ages of 12 and 16, the rate is $2.00 per night, and for children over 16 the rate is $3.50 per night in a single room. Children under 12 are not accommodated in the dormitories. M.I.T. dining facilities will be available for three meals a day. All meals are served cafeteria style.

Hotels

There are many major hotels located in Boston, and some in Cambridge, all located within a two-mile radius of M.I.T., and all accessible to the Kresge Auditorium by public transportation. Representative rates in leading hotels in the area are:

Single	$7.00 to $9.00
Double	10.00 to 14.00
Twin	12.00 to 15.00

These hotels also operate under a Family Plan, by which children under 14 are admitted free.

Motels

There are numerous motels of wide variety in the Greater Boston area. Most of these are located on the major traffic arteries into the area, and few are located closer than 8 to 10 miles from M.I.T. Representative rates for some better-quality motels are:

Single	$6.00 and up
Couple	8.00
Family (one room)	$9.00 to 10.00

Reservations and Information

For those who have not already given notification of tentative plans to attend the Conference, the coupon on page 133 should be checked as to whether M.I.T. dormitory housing, hotel housing, or motel housing is desired. Advance reservations in the dormitories will be made for those indicating a choice for this type of housing. Information on hotels and motels will be sent to those preferring this form of accommodation. Actual reservation with hotels and motels must be made by the individuals attending the conference. For this reason, it is advisable to return the coupon on page 133 as soon as possible in order to obtain the necessary housing information.

THE READERS WRITE

Convergence of meridians affects survey accuracy

To the Editor: I read with interest the article by Prof. Henry F. Soehngen, "Laying Out True Meridians in Defense Plants," in the May issue. It appears that Professor Soehngen neglected to take into account the convergence of meridians. Referring to Fig. 1, which accompanies his article on page 50, it is obvious that the meridian lines within the building were made parallel to the meridian through point *A*.

The east and west distance between points *A* and *D*, as scaled roughly, is about 338 ft. Assuming this defense plant to be in Seattle, Wash., at a latitude of 47½ deg, the difference in longitude between these points would be about 4.93 sec of arc. This, multiplied by the sine of the latitude, is 3.6 sec, or the amount of convergence of the meridians between points *A* and *D*. Therefore the meridian as laid out through *D* is in error by this amount even though the surveying work was perfectly performed. This is an appreciable part of the specified accuracy of 5 sec.

The same holds true for the meridians through points *C* and *N* in slightly different amounts. Although in this case the error resulting from the neglect of the convergence of meridians is not serious, it could be so where greater distances were involved, particularly in higher latitudes.

Lansing G. Simmons, M. ASCE
Geodetic Engineer,
Coast and Geodetic Survey
Washington, D. C.

Author replies

To the Editor: The point Mr. Simmons makes is true as far as the indications in the original article go. As a matter of fact, the convergence of the meridians for the actual site, which is considerably to the south of the latitude assumed by Mr. Simmons, was calculated and the small amount factored into the field work.

Henry F. Soehngen, A.M. ASCE
Assoc. Prof. of Civil Eng.
Polytechnic Inst. of Brooklyn
New York, N. Y.

Credit for design of dam

To the Editor: In the April 1957 issue, page 91, in describing the Chao Phya River irrigation and navigation dam in Thailand, it is incorrectly stated that Tippetts-Abbett-McCarthy-Stratton are the engineers on the project. The project was planned in the Department of Irrigation of the Government of Thailand assisted by the U. S. Bureau of Reclamation. We request that the statement be corrected to give proper credit.

As a matter of interest, however, it might be mentioned that August L. Ahlf, M. ASCE, who is now associated with our firm in our Baghdad office, was formerly designing engineer for the Bureau of Reclamation on this project. Recently while I was in Bangkok I had the pleasure of attending the ceremonies in which Mr. Ahlf was decorated with the Order of the Elephant by the King of Thailand in recognition of his prominent part in the planning of the Chao Phya Dam. The citation was presented by His Excellency Xujate Kambhu, Thailand's Minister at Large and Director General of Irrigation.

Robert W. Abbett, M. ASCE
Tippetts-Abbett-McCarthy-Stratton
New York, N. Y.

[An article by Mr. Ahlf on Thailand's Chao Phya River dam will appear in an early issue.—Editor]

SOCIETY NEWS

ASCE Buffalo Convention Features St. Lawrence Project

A billion dollars of construction on the St. Lawrence River, plus water use on the Great Lakes, was the theme of the ASCE Convention held in Buffalo, N. Y., June 3 to 6. The Buffalo Section made the Convention an international meeting, with Canadian speakers on projects of unusual interest and with tours to construction work on the north side of the world's friendliest border. Wind-up of the meeting was a trip, via Canadian National Railway, to the International Rapids Section of the St. Lawrence development where $75 million worth of construction equipment is rushing $750 million of work to completion. Convention papers on the St. Lawrence and Great Lakes projects are featured in this issue. Another article describes the work seen on the St. Lawrence tour.

Steven Pankow, mayor of Buffalo, the "Good Neighbor City," decreed Engineer Week and made ASCE President Mason Lockwood deputy commissioner of Buffalo police. But it was Edward Noonan, president of the Buffalo Section, with Nathan Schwartzman, general chairman of the Convention, and the work of the entire Buffalo Section and its ladies that made the meeting enjoyable and successful.

More Research Urged

A challenge to the future was laid down at the opening luncheon of the Convention by Clifford C. Furnas, chancellor of the University of Buffalo and until recently Under Secretary of Defense for Research and Development. He predicted an increase, in the next three generations, of world population from 2½ to 6 billion people and in the United States from 165 to 375 million with greater per capita use of natural resources. Dr. Furnas stated that much more reliance must be placed on industrial production as it will not be possible to support such a tremendous population with the present subsistence agriculture. He estimated that within 100 years world demand for energy will increase 50 fold, and that it will increase at least 10 fold within 30 years. Fossil fuels (coal, oil and gas) will not long be adequate; large-scale use of nuclear power is inevitable.

To meet future needs Dr. Furnas recommended intensified research and development in the fields of (1) production of liquid fuel by accelerated photochemical reaction similar to that which originally produced our fossil fuels; (2) saline water conversion—present methods cost five to ten times the amount considered acceptable for industrial and agricultural use; and (3) production of many additional materials from sea water as it is being processed into usable water. But time is important, and the Russians are ahead of us in much research, Dr. Furnas emphasized.

At the Convention dinner Secretary of the Army Wilbur M. Brucker told the engineers it is absolutely necessary that money for research and development be made available as well as the funds to maintain army strength throughout the world. The funds now requested by the Army and President Eisenhower are a minimum. Of prime importance is maintaining adequate engineering forces including those for on-the-ground operations.

Louis Howson (right), consulting engineer from Chicago and official nominee of the Board of Direction for next President of ASCE, is shown with Mason Lockwood, who retires as President in October.

Bertram D. Tallamy (left), Federal Highway Administrator and former chairman of the New York Thruway Authority, speaks at the Highway Division Luncheon, presided over by Edward J. Nunan, president of the Buffalo Section.

Col. L. W. Olmstead (left), of the Corps of Engineers, Buffalo, who handled the St. Lawrence tour, talks with Roger Gilman, of the Port of New York Authority, and Col. L. B. Feagin assigned to the Mississippi River Commission.

Construction Division Executive Committee, in session at Buffalo, includes, Dan Morris, Warren Riker (vice-chairman, Executive Committee), Alexander Brest, William Quirk, William F. Kennedy, John J. Senesy, and John S. M. Zimmerman.

Administrator Tallamy Speaks

Bertram D. Tallamy, M. ASCE, Federal Highway Administrator, returned to his home town of Buffalo to tell a large group at the Highway Division luncheon that the $50 billion U.S. road program is on schedule. Some states are lagging but others, including New York, are off to a fast start. He emphasized that $27½ billion is for the 41,000-mile Interstate System, of which 90 percent is federal contribution. (As of June 1 there are 1,241 miles of expressway under contract at a price of $1.2 billion.) The rest of the $50 billion is for urban, other primary and secondary roads with matching federal funds available.

Mr. Tallamy recommended that highway location engineers get away from the old concepts and plan utterly different profiles, emphasizing esthetic values—take advantage of a hillside, straddle a creek, separate lanes around a grove of trees and the like. And send the men out in the field; do not try to visualize it all in the office. That this has paid off on the New York Thruway is evidenced by an accident rate only 10 percent of that for the state.

There is no shortage yet of reinforcing steel. Structural steel delivery is improving. Prestressed concrete units are being used increasingly, but there is a problem of shortage of skilled designers and fabricators. The controversial "freeze" stipulation on employees of highway agencies is being modified, Mr. Tallamy stated. Some regulation will be retained to avoid flagrant raiding. An additional ¾ of 1 percent federal contribution may be made for roads where advertising is banned if a bill now in committee is passed. Mr. Tallamy personally favors banning all advertising except names of industrial plants along the road but recognizes state rights to regulate this activity.

John W. Johnson, M. ASCE, Superintendent of Public Works of New York State, advocated that utilities using public rights of way be compelled to make changes at their own expense. In New York this can amount to $90 million, which presumably would be passed on to users but would not require highway funds. States are divided on this requirement. Mr. Johnson commented that the Federal Bureau of Public Roads considers the 577-mile New York Thruway as included in the Interstate System so that mileage in the state eligible for 90 percent federal aid is cut in half. Laws being considered would permit reimbursement of money recently spent for toll roads that can become part of the Interstate System.

For first time since graduation Lawrence Elsner (left), Director of ASCE, meets Purdue classmate, Clifford C. Furnas, chancellor of the University of Buffalo and Welcoming Luncheon speaker. At right is Chairman Nathan Schwartzman.

Structural Division hears about activities in Canada from H. John Racey (left), "Lessons from Concrete Failure"; Per Hall, "Design of Deas Island Tunnel"; D. A. Chamberlain, Jr., "Prestressed Bracing in Queen Elizabeth Hotel."

In this Convention get-together are (left to right) Charles MacDonald, Tarrytown, N. Y., consultant; Howard Dixon, contractor of New York City; George Unger, bridge engineer of Buffalo; and Elmer Issak, New York City consultant.

Sixty engineers and twenty draftsmen recently were recruited in England for road design, W. J. Fulton, Deputy Minister of Highways of Ontario, told a Highway Division session. Ontario plans 1,820 miles of multi-lane roadway construction at a cost of $1.9 billion over 20 years. Ontario uses prequalification of bidders, restricts advertising signs in size and number. Field Advertising signs must be at least 1,000 ft apart, and have a permit for which a fee is charged.

St. Lawrence Excavation Problems

Excavation has been a major problem on the St. Lawrence as brought out by a Soils Mechanics Symposium. A paper by Ellis L. Armstrong and Richard E. Burnett, both Members ASCE and with Uhl, Hall and Rich [Mr. Armstrong has just become Director of the Utah Road Commission], outlined the earthmoving on the International Rapids section. About 146 million cu yd of materials are to be moved, representing 30 percent of on-site construction cost; more than 60 percent of this is completed. Equipment working on this includes 135 shovels and draglines (475-cu yd total capacity) ranging up to 15 cu yd, walking draglines, 400 crawler tractors, 85 scrapers, 730 trucks (to 25-cu yd capacity) and 8 dredges.

Soil is mostly glacial till and marine clays. The till in its natural state is very compact, 140 to 150 lb per cu ft, but fall rains penetrate deeply and freezing extends to 5 ft. The saturated tills are not stable under travel of construction equipment and surfacing is required for haul roads. Except on a deeply dried firm surface travel on the clay soils is almost impossible by any class of heavy equipment. As much as 5 ft of gravel has been necessary to maintain a haul road.

Almost all types of excavating equipment have been used in handling these materials:

1. Shovels ranging in size from 2½ to 6 cu yd are most effective where foundation conditions are suitable for hauling equipment traveling on the same level as the shovels. Generally there is little difference in the rate of excavation per cubic yard of bucket capacity for different sizes of equipment operating under similar conditions.
2. Draglines ranging from 3½ to 15 cu yd are employed, the majority in the 5½-cu yd range. The large draglines are most effective where materials can be deposited directly into spoil and are better than small machines in compact, unblasted tills. It has been found economical to rehandle excavated material by draglines twice to its final position in disposal rather than load and haul.
3. Wheel and track tractor-drawn scrapers up to 24-cu yd capacity are used most effectively for stripping off topsoil, for rehandling of stockpile till, and for dressing disposal areas. This equipment is not effective in excavating soft marine clays or moving compact glacial tills without prior loosening. Marine clays are most readily handled during the winter months when the ground is frozen. Excavating this material at any season of the year is easy but disposal is almost impossible during the summer months except by casting.

Construction Division Meets

"Hold harmless" and liability clauses in some construction contracts are so drastic that contractors should refuse to accept them, Warren Riker, vice-chairman of the Construction Division and New England manager for the Raymond Concrete Pile Co., told a Construction Division session. Liabilities may be many million dollars on jobs with a few thousand potential profit. Morris Slute, New York construction insurance broker, warned that such coverage is not included in ordinary policies. The attention of the broker should be called to such requirements and specific endorsement obtained. Mr. Riker's firm declines to bid where it must provide excessive protection for a client's continuing operations or for damage beyond its reasonable control.

In line with this, the Construction Division plans a manual on construction insurance that will outline needs, available coverage, and special precautions necessary.

Inspection Trips Popular

While the St. Lawrence tour was the great drawing card, many attending the Convention also took a look at projects in the Buffalo area, including the Huntley Steam Station of Niagara Mohawk Power Corp. and the Buffalo plant of the Bethlehem Steel Co., sixth largest in the world. Of special interest was the Power Division's trip to the Sir Adam Beck Hydroelectric Station on the Canadian side of Niagara. Otto Holden, a former Director of ASCE and chief engineer of the Hydro-Electric Power Commission of Ontario, was host for his firm. Installed capacity is 1,953,000 hp, of which the last units are now being installed. A feature is night-pumped water storage for daytime peaking. Also visited were the Remedial Works above Niagara Falls where controls for flow over the Falls are just being completed.

Conditions of Practice Sessions

Conditions of Practice sessions centered on young engineers—their number, Society participation, remuneration, and change of name within ASCE. Executive Secretary Wisely outlined to an interested luncheon audience the comparison of young engineers in ASCE with those in other major engineering societies. His paper appears elsewhere in this department.

Prof. William LaLonde outlined a proposed change in ASCE membership designations. All members will be asked to express an opinion on the proposed revision as a guide to the Board of Direction in proposing a change in the constitution. The plan is reported elsewhere in "Society News."

Frank Edwards, M. ASCE, of Stanley Engineering Co., Chicago reported on research into indoctrination into a profession. The young doctor, he said, is imbued with the ideals and ethics of his profession while in medical college, and an interne, coming out, is fully indoctrinated with the idea that he (1) must continue to educate himself throughout his life and (2) has a right to make a good living. In short the doctor starts as a professional man; the graduate engineer is just learning to be one.

Trent Dames, consultant of Los Angeles and chairman of the ASCE Committee on Junior Members, outlined causes of Junior Members dropping out rather than transferring to a higher grade. These include: Increase in expense; change to other work; no activity on committees to which they are assigned; lack of "responsible charge" experience required for transfer; benefits of membership are not enough to warrant staying in the Society. Some delay transfer as long as possible because more activities are open to a Junior Member—that is, additional meetings, courses for professional license, and opportunities to serve as an officer.

Using the theme "Registration Is a Must for Professional Recognition," Newell L. Freeman, of the New York Board of Examiners of Professional Engineers and Land Surveyors, led a Canadian—U.S. session on registration. Registration is legal and has formal recognition and has now become fashionable, said Mr. Freeman.

Speaking for Canada, J. Murray Muir, of Toronto, stated that administration of Provincial legislation is placed in the hands of Provincial Associations, which are given the responsibility of maintaining a high standard of ethics and whose Council possesses disciplinary powers. The several Provinces have different regulations. The principal difference is in experience required before registration, which now is generally two years. Ontario has recently started voluntary certification of engineering technicians. By encouraging development of technicians it is expected that engineers doing routine work can be released for professional jobs. The plan is expected to show a more definite demarcation between the professional and the technician, rather than lend status as a professional engineer or lead to membership in the professional group.

The problems of enforcement of registration law were detailed by Vincent G. Terenzio, M. ASCE, of the Board of Water Supply of New York City. The big difference is the interpretation put on the law by the lawyer who accepts only what is written in the statute and the engineer who accepts long-standing practice as a guide. Firms may use the word Engineer in their title legally until legislation specifically states that this is wrong. The worst sins under the law are committed by those doing work of presumably limited responsibility under qualified supervision. Many believe that avoidance of the engineering title leaves them in the clear. They do not recognize that the law is directly concerned with performance. New York courts recognize professional engineers and registered architects to be on an equal basis so they may work together, but an engineer and a surveyor or an engineer and a businessman may not combine. Prosecution of violators is slow and uncertain, the best defense being refusal of a client to pay. The courts will not sustain a benefit from a criminal act, Mr. Terenzio said.

Credit Where It Is Due

Though it is impossible to give full credit to all who did so much to make the Convention the well-rounded event it was, certain names inevitably come to mind. Aiding General Chairman Nathan Schwartzman were Louis S. Bernstein, chairman of the Technical Program Committee, and Col. Loren W. Olmstead, chairman of the St. Lawrence Tour Committee. In addition to his responsibilities as president of the host Section, Ed Nunan capably doubled as chairman of the Arrangements and Entertainment Committee. The much-applauded ladies' program was headed by Mrs. Ralph H. Gallinger, who had Mrs. Olmstead and Miss Mildred E. Schudt as vice-chairmen.

What the Board Did at Buffalo

During the Buffalo Convention, on June 3 and 4, the Board of Direction met in the Statler Hotel, with President Lockwood in the chair and every member present at all sessions. A number of important actions were taken. Among them are the following:

Louis Howson Nominated

By unanimous vote of the nominating committee, Louis R. Howson, Chicago consultant and recent ASCE Vice-President, was named official nominee for President of the Society for the coming year. Mr. Howson accepted the nomination and was presented to the Board.

Honorary Members Elected

The Board elected the following new Honorary Members:

Lorenzo Perez Castro, Mexico City
Prof. Whitney Clark Huntington, Urbana, Ill.
Dr. Karl Imhoff, Essen, Germany
Howard Scott Morse, Indianapolis, Ind.

Conventions and Conferences

Frank A. Marston, chairman of the Committee on Meetings, reported consideration of several invitations for future Conventions. (The complete list of scheduled Conventions, previously approved by the Board for 1958, 1959, and 1960, is given on page 77 of the April issue, and the 1957 listing is on a following page of this issue.)

Chairman Marston, of the Committee on Division Activities, reported the success and value to the membership of recent Technical Division Conferences, and announced that in 1958 there will be a Nuclear Congress, an Engineering Mechanics Conference, and another Hydraulics Conference (Atlanta). The dates of these conferences are listed on another page of this section.

Technical Publications

Prof. Jewell Garrelts, chairman of the Publications Committee, reported publication and distribution of the first Journal of the Pipeline Division in March. He reported, also, that the Power Division and the Waterways and Harbors Division are the most active in the Society's technical publication program on the basis of relative membership enrollment. Enrollment in the Technical Divisions is increasing fast, with 15,423 new enrollments added during the year ending June 1, 1957.

The Board approved a recommendation that Division newsletters be prepared separately from the Journals but mailed in the same container as the Journal.

Budget

Reporting for the Budget Committee, Chairman Francis S. Friel announced that Society receipts for the first seven months of the fiscal year are above, and expenses below, budget anticipation to date. He noted, particularly, that Technical Division appropriations have not been fully utilized.

Department of Conditions of Practice

Chairman Norman Moore presented the Department's report. The following actions were taken by the Board.

The interim report of the Task Committee on *Classification of Members* was received and considered. It was ordered printed in CIVIL ENGINEERING and distributed for review and comment of the membership. (The report is printed elsewhere in this department.)

A recommendation of the Committee on *Engineering Education* was approved. It proposed creation of a Task Committee on Professional Development for the purpose of studying the professional attitude of students and young members of the profession and recommending appropriate action.

Acting on the recommendation of the Committee on *Professional Practice,* the Board voted its unalterable opposition to the U. S. Bureau of Public Roads' recent memorandum recommending that consultants and highway departments agree not to engage technical or professional personnel who have been or are employed by the Bureau or any highway department. However, the Board considered it highly improper for consultants to employ on any basis during the period of their contract any engineering or technical personnel in the employ of the public agency which is the other party to the contract, or for such employees to accept such employment. (See, also, the June issue, page 79.)

The 1957 *Salary Survey Report* was approved and ordered abstracted in CIVIL ENGINEERING and printed in full in the Journal of the Board of Direction. (See a following page of this issue for the abstract.)

Establishment of a Student Chapter at Southwestern Louisiana Institute, recommended by the Committee on *Student Chapters,* was approved.

Research Committee

Director Randle B. Alexander, contact member of the Research Committee, presented its report which made note of the increase in Engineering Foundation allotments for research in the field of civil engineering from $6,500 in 1956-1957 to about $18,000 in 1957-1958, nearly all for research in the structural field. The report made a plea for increased awareness and interest on the part of the Technical Divisions in research and sponsorship of research.

United Engineering Center

The Board authorized a loan of $500,000 to United Engineering Trustees for the purchase of land for the United Engineering Center building in New York. Formulation of a fund-raising program, through a group of engineering leaders in industry and education headed by Dr. M. J. Kelly, is proceeding aggressively. The five participating societies have appointed committees, which are developing a campaign to secure gifts from individual members.

Prizes and Awards

Prizes and awards for papers published in Vol. 121 of TRANSACTIONS and in CIVIL ENGINEERING were approved. The winners' names are listed elsewhere in this department.

Technical Division Appointments

Appointments to the Executive Committees of the Technical Divisions were approved. The appointees will be listed in the August issue.

Mead Prize Competition

The following topics were approved for the 1958 Mead Prize Competition. Junior Members will write on "What procedures can be used in negotiating for engineering services to eliminate competition on a price basis?" The Student topic will be, "Ethical aspects of current practices in the recruitment of graduating engineers."

Freeman Fellowship

A Freeman Fellowship, in the sum of $3,000, was awarded to Norbert L. Ackermann, J. M. ASCE, instructor in civil engineering at Carnegie Institute of Technology, for the 1957-1958 school year. Mr. Ackermann will continue his studies in the field of hydraulics.

Board and Staff Travel

Since March 1 members of the Board have made nearly 90 visits with Local Sections, Student Chapters, and other groups of members. Of these President Lockwood accounted for 26. Staff personnel made 40 such visits, including 15 by Secretary Wisely.

Next Board Meeting

The next meeting of the Board of Direction is scheduled for October 14, 1957, in the Statler Hotel, New York, during the week of the Annual Convention.

Four Elevated to Honorary Membership

Four members of ASCE were elected to honorary membership in the Society during the Buffalo meeting of the Board of Direction. This year's elections include two distinguished foreign engineers—Karl Imhoff, of Essen, Germany, and Lorenzo Perez Castro, of Mexico City. United States engineers honored are Howard S. Morse, of Indianapolis, Ind., and Whitney C. Huntington, of Urbana, Ill. Presentation of their honorary memberships will be a feature of the Annual Convention in October.

A sanitary engineer of world renown, Dr. Imhoff is responsible for many inventions and techniques that have improved water recovery and treatment, including the tank bearing his name. He is also author of a universally used text on sewage treatment. Since the war he has had a consulting practice in Essen.

Mr. Perez Castro is an eminent Mexican railroad engineer and executive with a long record of accomplishment in developing the transportation facilities of his country. At the time of his retirement in 1954 he had held a top engineering post with the Mexican Railroad for twenty years. Long a member of the Society, he has been active in the Mexico Section since its formation in 1949 and was Section president last year.

A noted engineering educator, Professor Huntington has brought distinction to the two institutions, the Universities of Colorado and Illinois, with which he has been connected during most of his career. From 1926 until his retirement last year he was professor of civil engineering and head of the department at the University of Illinois. He has been active also in building up the university's Engineering Experiment Station there, and during his administration annual civil engineering research expenditures increased from about $15,000 to about $640,000.

Mr. Morse has been connected with the Indianapolis Water Company since 1925 as manager, vice-president, and president, and is now chairman of the board. During his 31-year association with the company it has become one of the leading water works industries of the nation. Long active in ASCE, Mr. Morse served as Director from 1935 to 1938. He is a former president of the Indiana Section, and currently is chairman of the Section's Advisory Committee to the Indiana Water Study Committee created by the 1955 General Assembly of Indiana.

Biographies and photos of the new Honorary Members will be published in the October issue.

The Young Engineer In ASCE—A Project

W. H. Wisely, M. ASCE

Executive Secretary, American Society of Civil Engineers, New York, N. Y.

The interests and needs of young ASCE members have been a source of concern within the Society for a good many years. In the Lockwood study of membership opinion in 1956, the status of the young engineer received mention in one way or another from 45 percent of the respondents [November 1956 issue, page 33]. Although there has been a plethora of discussion—oral and written—factual documentation on the subject seems to be limited and scattering. Opinion ranges widely, as is to be expected when it is based mainly upon conjecture and generalities.

This is an attempt to present facts in the form in which they are most readily digested and evaluated by engineers—as statistical data. It is admitted that figures can lie, but the engineer is trained to see through their vagaries and pitfalls, and to interpret them in terms of their true meaning.

Several good members of the headquarters staff assisted in the assembly of the data that are reported here. I acknowledge their help with sincere thanks.

To give this presentation an orderly pattern, I propose to trace the young engineer from his student days through the early years of his career to his rise to status as a professional engineer. The latter milestone will be considered to be marked by his advancement from the grade of Junior Member in the Society. Statistics will be used to show how he responds and participates in Society affairs and activities, and even how he thinks on some questions. From these data we may be able to develop a reasonably accurate portrayal of the relationship of the young engineer and the Society, and possibly to derive some ideas as to how that relationship might be improved to mutual advantage.

The Civil Engineering Student

Table I compares the extent of student participation in the five major engineering societies. ASCE is the only society which limits the student to membership in a Student Chapter; the other societies have a Student Member grade. The soundness of our Student Chapter plan in attracting student interest and participation is obvious.

The extent to which graduating students become members of their professional society is also a measure of the effectiveness of the student program. In Table II it is manifest that ASCE fares best of the five. Nevertheless, it is disappointing to discover that only half the new crop of civil engineers is appreciative of the value of ASCE membership at the time of graduation.

In 1956 there were 275 admissions to the Junior Member grade other than from graduating classes. Thus, almost nine out of ten of the Society's Junior Members have entered as graduating students.

TABLE I. Student participation in engineering societies (1955-56)

Society	Total Student Enrollment in Engineering[*]	Type of Student Participation	Annual Dues per Member	No. of Students Participating (1956)	% of Enrollment Participating
ASCE	26,486	Student Chapters	[†]	10,300	39
AIChE	16,996	Individual members	$1.00	2,000	12
AIEE	51,650	Individual members	$5.00	8,000	15
AIME	8,463	Individual members	$4.50	3,400	40
ASME	47,412	Individual members	$3.00	7,700	16

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[*] U. S. Dept. of Health, Education and Welfare, 1955 report. Includes all undergraduate students, freshmen through seniors.

[†] Set by each Chapter; usually nominal (about $1.00 per semester).

The Junior Member

The Junior Member period is an important transitional phase in which the engineering graduate acquires the experience, judgment and confidence that enable him to assume greater responsibilities. In ASCE this is a trial period—like an internship—during which the young engineer is expected to advance himself by the time he is 32 years of age to meet the professional qualifications that will entitle him to permanent membership.

The age bracket of 21 to 35 is represented here, and it is understandable that the progressive young man in his late twenties or early thirties finds the appellation of "Junior" distasteful. The extent of this dissatisfaction has not been measured, but it is sufficiently outspoken and widespread to merit official attention. The imposition in recent years of a universal military obligation has extended the constitutional age limit, now 32 years, for the mandatory advancement to professional grade of membership (Associate Member or Member). Administration would be simplified and improved by replacing the present age-limit by a time-limit.

In 1947 the Society Constitution was amended to give Junior Members full "corporate" status, with all membership privileges including the right to vote and to hold office. Before that time Junior Members comprised about 30 percent of the total membership. In 1956, the 17,300 enfranchised Junior Members represented 44.6 percent of the total, as compared to the all-time high of 46.9 percent in 1953. The present rate of increase in Junior Members is less than the rate of growth of the Society, but this trend could reverse as the present large student enrollments begin to graduate.

Local Section Activity

Interesting data on Junior Member participation in Local Section affairs are provided by the Committee on Junior Members [January 1957 issue, page 77].

First, it is noteworthy that 47 Local Sections reported that only 35.2 percent of Junior Members paid Local Section dues as compared to 64.8 percent of the Members and Associate Members combined. In 1956, 53 percent of all Members paid dues to their Local Section.

The same survey revealed that 33 of 48 Local Sections numbered one or more Junior Members among their officers. A check of current presidents and secretaries of Local Sections and Branches disclosed that 65 Junior Members—24 percent—were included among the 270 names. This presentation appears to be in proper order when it is noted that eligibility to hold office in a Local Section requires dues-paying membership.

The Committee on Junior Members also studied participation by Juniors in Local Section committees. The range was broad, with Junior Members constituting from 5 to 72 percent of the total personnel of all committees. The median was 29 percent, which is also in line with dues-paying membership.

Obviously there is a job to be done in attracting young engineers to dues-paying participation in Local Section affairs. Once he surmounts this financial hurdle, we find that he does very well in assuming his share of the work and the leadership.

Technical Activities

Is the young engineer given opportunity to contribute to his profession through participation in the technical activities of the Society? Does he take advantage of these opportunities?

Using publications as criteria, we find that Junior Member contributions in 1956 to CIVIL ENGINEERING and to the Technical Division Journals were as follows:

	Number of Authors: Total	Number of Authors: Junior Members	Percent Junior Members
Division Journals	581	58	10
CIVIL ENGINEERING	138	18	13

It should be noted that the foregoing figures represent minimum publications activity, as many young engineers who have already transferred to the Associate Member grade are also contributors to publications.

Participation on Technical Division committees is also readily measured, and we find that there were 48 Junior Members among the total of 740 Society Members who are currently serving on 266 committees. In 1952 the roster of technical committees included less than 1 percent of Junior Members, as compared to 6.5 percent today.

While some progress is being made, it appears that there should be much more activity in technical functions than now exists. This is an area, however, in which the initiative of the young engineer is the important element. He must make his services and contributions available, and he must be prepared to give of his time and energy to the work at hand.

Participation in Meetings

Certainly one of the most important benefits of Society membership to the young engineer is the opportunity to make contacts with leading contemporaries. The 1956 Annual Convention at Pittsburgh has been chosen as a typical national meeting for an attendance and program participation study.

Of the total registration of members of the Society, about 15 percent were in the Junior Member grade. Of the complete list of 178 authors and co-authors contributing to the program, 15 of them, or 8.5 percent, were Junior Members.

No data are available on attendance at Local Section meetings, but a check was taken among the headquarters personnel who visit many of these meetings each year. It was unanimously the opinion that Junior Member attendance at local meetings was far below, perhaps less than half, the 45 percent membership ratio previously reported for Junior Members in 1956.

Admittedly these data are meager, but they do indicate an area that deserves significant and prompt attention. In this instance, it is not the young engineer who needs to be sold, but rather his employer.

Viewpoint of the Young Engineer

A 1956 study [January 1957 issue, page 79] by the San Francisco Section's Junior Member Forum provides a hint to the trend of thinking of the young engineer. Two-thirds of the replies to a questionnaire cited low salaries as the major inadequacy of the civil engineering field. Salaries of engineers after ten years of practice were held to be only 60 percent of the "desired" level. The best way to remedy such deficiency in economic status was thought to be a "revised status" of ASCE that would permit the Society "to improve the salary situation and to obtain better professional recognition."

TABLE II. Admissions of graduates to membership in engineering societies (1956)

Society	Degrees Conferred in Engineering*	No. of Graduates Admitted	% of Graduates Admitted
ASCE	4,450 (civil)	2,122	48
AIChE	2,450 (chemical)	228	9
AIEE	5,650 (electrical)	1,699	30
AIME	1,450 (mining, etc.)	540	37
ASME	6,600 (mechanical)	2,100 (est.)	32

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* ECPD accredited schools only; Engineering Manpower Commission.

TABLE III. Comparison of losses in entrance grade

Society	Total Membership in Entrance Grade	Losses in Entrance Grade: Resigned	Losses in Entrance Grade: Non-payment	Losses in Entrance Grade: Age Limit	Losses in Entrance Grade: Total	% Loss of Members from Entrance Grade
ASCE	17,245	189	904	361	1,454	8.4
AIChE	6,972	106	172	—	278	4.0
AIEE	21,087	279	714	—	993	4.7
AIME	4,780	66	160	—	226	4.8
ASME	17,662	159	923	—	1,082	6.1

TABLE IV. Comparison of losses in other than entrance grade

Three-year average, 1954-1956

Society	Membership in all Except Entrance Grade	Losses in Membership: Resigned	Losses in Membership: Non-payment	Losses in Membership: Total	% Loss in all Except Entrance Grade
ASCE	19,956	105	202	307	1.5
AIChE	7,051	78	64	142	2.0
AIEE	26,360	372	508	880	3.3
AIME	15,279	173	341	514	3.4
ASME	21,818	296	630	926	4.2

TABLE V. Comparison of losses in all membership grades

Three-year average, 1954-1956

Society	Total Membership	Losses in Membership: Resigned	Losses in Membership: Non-payment	Losses in Membership: Age Limit	Losses in Membership: Total	% Loss from all Grades
ASCE	37,201	294	1,106	361	1,761	4.7
AIChE	14,023	184	236	—	420	3.0
AIEE	47,447	651	1,222	—	1,873	3.9
AIME	20,059	239	501	—	740	3.7
ASME	39,480	455	1,553	—	2,008	5.1

A few Junior Members—in their mail and comments to Society officials—are not nearly as restrained as is the San Francisco Junior Member Forum in their condemnation of ASCE for its negligence in failing to raise the economic status of its members. Most disturbing here is the too frequent comparison with what the unions claim to do, implying that the purposes and aims of a professional society and a union are similar or comparable. It is obvious that some young engineers have affiliated with the Society without a proper understanding of professionalism, and they are expecting a form of activity and representation that is not available in organizations like ASCE.

It is only natural that the young engineer in the 21-35 age group places more emphasis upon economic factors than do his elders. It is in this period that new homes and families are begun, and it is not easy to hold to a balanced household budget today in an inflating economy. A measure of the young man's viewpoint here is found in the 1953 survey by the Committee on Employment Conditions, in which 44 percent of Junior Member respondents were "not opposed" to collective bargaining as compared to 35 percent of the Associate Members and 28 percent of the Members.

There is ready proof, however, that the vast majority of the Society's young members are solidly oriented toward professional careers, and are prepared to assume the personal responsibilities involved. The San Francisco Junior Member Forum found its members to be 18-to-1 against voluntary union membership, and five of every six would seek other employment if confronted by compulsion to join a trade union.

Membership Losses

Extreme concern has been expressed on many occasions about the loss of Junior Members through resignation, non-payment of dues, and failure to qualify for advancement to the Associate Member grade at the required age. Considerable care has been taken in assembling these data to insure accuracy and significance. The figures in Tables III, IV, and V represent three-year averages, to eliminate distortion resulting from dues increases or other short-term influences.

Note first, in Table III, that ASCE is the only one of the five societies which requires that a member achieve professional status—as defined by Associate Member requirements—in order to become a permanent member. Lifetime membership can be maintained in the other four societies merely upon the basis of graduation from an accredited curriculum and payment of dues thereafter. It is evident that attrition in ASCE because of the Junior Member age limit is substantial, but that losses by resignation and non-payment of dues are in line with the experience of the other societies.

It is logical, however, that the selective admission of members to the Associate Member and Member classifications should up-grade these classes. If true, membership in those grades other than the entrance grade should be more stable in ASCE than in the other societies. This is brought out sharply in Table IV, where it will be seen that ASCE losses in the upper grades of membership are generally one-third to one-half the losses in its fellow societies.

Table V compares the totals of membership losses in all grades. It is clear that the over-all loss rate in ASCE is in the same order as is experienced by the other societies, in spite of the age limit requirement in the ASCE Junior Member grade. The apparently heavy loss rate in the Junior Member grade is largely offset by the remarkably low loss rate in the advanced grades.

There is no cause for satisfaction or complacency, however, in the 4.7 over-all loss rate that is reported for ASCE in Table V. This should stand as a pointed reminder that the Society has a constant challenge to improve its publications, services, and membership relations.

A study was made, in 1953, of the ages of Junior Members who were dropped in that year for non-payment of dues. It revealed that 70 percent of the loss occurred in the 26-31 age range. This is about what should be expected, for it is in this age bracket that growing family responsibilities may outpace financial progress. The effect of those leaving engineering for other employment may also be a factor here, as it is in the age-limit loss rate.

Unfortunately, there is no information available prior to 1955 on the number of Junior Members reaching the transfer age who actually failed to consummate the transfer in their last year. Promotional activity should certainly be directed toward these young men at this particular time to urge, and assist, them to transfer if they can qualify. In 1955, 61 percent of those reaching the transfer age in that year failed to transfer. Improved provision for notice from headquarters, together with more direct contact and promotional effort by Local Sections, reduced this loss rate to 41 percent in 1956. This can be further improved, and steps to do so are being taken.

Society Recognition of Junior Members

It certainly cannot be said that ASCE has not been sympathetic and beneficent to the interests of its young engineers. A brief summary of the special considerations and policies that have been authorized in behalf of Junior Members may be helpful in translating the foregoing information into a pattern of action.

Junior Members receive all benefits of membership enjoyed by the Associate Member and Member grades at an annual dues rate of $15.00. It is noteworthy that the value of all publications and services produced by the Society in 1956 was about $32.00 per member.

A standing Committee on Junior Members reports directly to the Board of Direction through the Department of Conditions of Practice. The statutory aim of the Committee is to recommend and execute "methods and procedures calculated to be of value to the Junior Members of the Society." The Committee has enjoyed consistent encouragement and support by the Board.

Local Sections are privileged to create Junior Member Forums as a means of expression and action for their young engineers. The forums have been found most constructive in the very large Local Sections, and they are currently functioning to advantage in the Los Angeles, Metropolitan, National Capital, Philadelphia, Pittsburgh, Sacramento and San Francisco Sections. Forums formerly operated in the Cleveland and Illinois Sections are now inactive.

In its provision for Local Section Conferences the Board has established minimum representation for Junior Members and has subsidized the travel expense of such delegates. Another Board policy specifically urges appointment of qualified Junior Members to Technical Division committees whenever possible. Outstanding accomplishment on the part of Junior Members is recognized by two major Society awards, the Collingwood Prize and the Daniel W. Mead Prize.

The foregoing benefits are all provided at national level. Some of the Local Sections offer further privilege and favor to their Junior Members.

Summary

Objective evaluation of the foregoing data indicates that the so-called "Junior Member Problem" is not nearly so serious as it has been pictured in some quarters. In many respects the future leaders of the Society are making the transition to professional status in fine style, and they are probably taking hold of their responsibilities just as well as did their predecessors.

Part of the alleged "problem" is entirely artificial in that it stems from a misunderstanding by some young members of the proper scope of a professional society. Another part results from the financial pressure which naturally—and always—has been felt by any young man who embarks simultaneously upon his career as a professional man and his responsibilities as head of a household. Moreover, there is some evidence of a lack of knowledge as to what the Society is already doing to advance the welfare of its members. This is in part the fault of the Society, and corrective steps have been initiated.

Basic policies of the Society with regard to its younger members are found to be sound and effective in comparison with other engineering societies. And there is certainly no reason for the young engineer to feel that he is a forgotten man; if anything there may be evidence that he is being exceedingly well remembered!

Let us think in terms of the young engineer's "project," instead of "problem." Certain very definite moves are clearly indicated by the facts. They are as follows:

1. *Professional Indoctrination of Students.* The planting and development of the professional concept in the civil engineering student could well be the number one aim of the Student Chapter program. This will insure that entering graduate members will know what to expect of the Society, and that they will be aware that the professional man receives only as he contributes to his environment. It is gratifying to report that the Committee on Student Chapters and the Committee on Junior Members are working cooperatively on a movement to encourage professional development courses and lectures in engineering schools.

2. *Responsibility of the Engineer in Management.* At least half the members of the Society are employers of engineers, or else they hold supervisory positions in which they have access to the management level. These are the men best able to initiate positive action in behalf of the young men in subordinate positions. The Committee on Junior Members would do well to direct some of its energy toward a continuing campaign to remind the engineer in management of his responsibility to exercise his influence constructively when there is occasion and opportunity. The AIChE has found such a program to be a most direct and effective barrier against unionism.

3. *Salaries and Fees.* Even now the Society is offering to cooperate with engineering employers in the development of proper job classifications and salary schedules. This marks a much more aggressive policy than that under which salary data were only gathered and published. The Committee on Salaries now maintains a continuing "Salary Index" for the guidance of employers. The new Committee on Engineers in Civil Service is directing Society support to salary and classification problems in that area. The Committee on Professional Practice is reviewing the fee curves in Manual 29 to enable consultants to maintain employee salary schedules that keep pace with the times.

4. *Meetings and Technical Activities.* Nearly all Society Conventions—and many Local Section meetings—require some expense and some loss of time from work. Thus, attendance at such meetings by the young engineer is usually dependent upon the generosity of his employer. A strong technical program will best justify employer consent and cooperation. Also, consideration for the harassed budget of the young engineer might well be kept in the minds of the meeting planners. Convention services, particularly meal functions, are very expensive nowadays, and the young people are sometimes out-priced.

Events affording occasion for mixing and fellowship are especially profitable for the young engineer as opportunity for professional contacts. Picnics and inspection trips are illustrative of low-cost functions of this kind

The young engineer must himself initiate his participation in technical committees and publications. Those offering committee service should do so through the secretary of the particular Technical Division, and papers for publication should be submitted to Society headquarters or offered for Convention programs through the Technical Divisions.

5. *Local Section Activities.* Something of a challenge to the Committee on Local Sections stands in the disproportionate number of young engineers who are not active as dues-paying members of the Local Sections. A continuing campaign is indicated.

Present representation of young men in Local Section offices and committees appears to be in proper ratio to dues-paying membership. In making nominations and appointments, however, age is less important as a qualification than are interest and willingness to work. There are plenty of dynamic and competent young members available, even if some of them must be sought out.

The Local Sections can make a further worthy contribution in their conduct of timely annual campaigns to encourage and aid the Junior Members approaching the mandatory transfer age. This activity varies widely in effectiveness between Sections and even in the same Section from year to year. There is nothing that is more helpful in expediting transfer applications than the personal contact of local members.

6. *Personal Encouragement.* Next, but not less important, is the human aspect of the assimilation of young engineers into the profession and the Society. This might be termed their "acceptance" by those who are already established. No doubt every engineer past age 35 will remember one or more particular incidents in the early days of his career when a word of greeting or a chat or a committee contact with some respected elder may have instilled a feeling of "belonging" as a fellow engineer. From these personal experiences derive the pride and confidence which round out the professional attitude.

Every veteran can make a contribution here simply by manifesting a friendly interest in his younger associates, and by passing along an occasional word of encouragement or commendation. The benefits from these relationships are by no means one sided, as many leading civil engineers well know.

7. *Administrative Action.* Amendment of the Constitution and Bylaws (*a*) to provide an acceptable replacement for the designation "Junior Member," and (*b*) to replace the present age limit for the entrance grade of membership with a time limit. These changes are among the sweeping revisions of Society membership requirements that are issuing from the Task Committee on Classification of Members (page 81).

I should like to think that the foregoing recommendations would banish forever the obstacles which beset the neophyte civil engineer on his path to professional status in the Society. The time and effort have been well spent, however, if these remarks do nothing more than array the significant aspects of the situation in something like their proper order and magnitude. I shall be more than content if this has been accomplished without a reaction on the part of any young engineers in the audience that I have been overly paternal or patronizing.

[*This article is a talk presented by Mr. Wisely at the Department of Conditions of Practice Luncheon during the Buffalo Convention.*]

ASCE Air Transport Division Sponsors Jet Age Airport Conference

"Recognizing the historical role the civil engineer has played in the development and advancement of all forms of transportation—in the highway field, railroads, rapid transit, inland waterways and marine transportation—it is logical to assume that the civil engineer has today an outstanding part in planning for introduction of turbine-powered aircraft into the world's civil air transport fleets." So said Joseph D. Blatt, chairman of the executive committee of the ASCE Air Transport Division and deputy regional administrator of the Civil Aeronautics Administration in New York, in opening the Jet Age Airport Conference in New York on May 15. The conference was sponsored by the Air Transport Division.

To plan and design the highly modern and efficient terminals that will be required to serve the aircraft of the future, the civil engineer must have a working knowledge of the operational and physical characteristics of the vehicles involved. He must know the capabilities and limitations of the navigation and traffic control facilities utilized by these vehicles. He must have knowledge of the economic soundness of the industry he is serving, and he must be aware of the maintenance and service requirements of this industry. The aviation industry, similarly, must be cognizant of the terminal designs that will be provided by the engineers.

Following Mr. Blatt's introduction, speakers from plane manufacturers, airlines, airport designers and operators as well as government officials covered the field from putting fuel into the planes to attempting to control the noise coming out of them on take-off from rebuilt airports. Specifically, the question for the conference was "How can the civil engineer provide economic and efficient terminals to handle the expected traffic?"

One help for existing airports came from James T. Pyle, U.S. Administrator of Civil Aeronautics, who told of means to speed up airport surface movements. Plans under way will make it possible for the big, new planes to make turns off the runway at 60 or 70 mph instead of slowing down to 10 or 20. His department hopes to order 74 sets of airport surface-detection equipment so that a plane on the ground can be tracked with accuracy when the controller cannot see the limits of the airport and when the pilot himself may be lost in darkness or thick weather. Conversation between the pilot and the control house must be eliminated. Decisions must be instantaneous; instructions must be brief—coded preferably; conversation is too time consuming. In fact, according to Mr. Pyle, airport traffic must be controlled as fast and as accurately as street traffic is by the lights at a street corner or the policeman who merely nods his clearance to automobiles.

Airports do not need to be much larger than or different from our present modern airports to accommodate the largest of the jet planes, according to James B. Edwards, assistant to the chief engineer of the Douglas Aircraft Co. Where airports are at high altitudes and weather is hot, long runways are required for take-off with a maximum load of passengers and fuel for a maximum range flight. Examples are Bogota, Colombia, and Mexico City, with airports at 7,300-ft elevation, where runways 14,500 ft long might be desirable.

Mr. Edwards reported some informal noise observations from the San Francisco terminal when a DC-8 was brought up to the ramp in test. The majority of travelers and airport personnel questioned objected to the high-pitched whine, particularly when the plane was approaching. Less than one-fourth felt it was desirable to stop the engines away from the ramp and tow the plane in. From this, Mr. Edwards concluded that glassed-in terminals and passenger fingers, such as exist at San Francisco, are adequate protection for taxi-to-ramp operation. Experts on the ramp were in agreement that field personnel required to be in exposed areas during the start-and-taxi operation should use ear-protective devices; blast fences are also desirable.

Revised airport configuration was recommended by W. E. Cullinan, Jr., chief of the Airports Division of the Civil Aeronautics Administration. Heavier planes, stronger and better designed landing gear make it less necessary to have and use secondary runways. In general, planes will be able to land on runways in a cross-wind, especially at times when instrument landing is necessary. In most cases, it is believed, a third-direction runway is not necessary, thus releasing space for a revised configuration.

Mr. Cullinan concluded that "the most efficient instrument runway plan is the open parallel design where parallel runways are separated by the terminal building and ramp area. Arrivals and departures are completely segregated, and any cross traffic is confined to the ramp area. With this arrangement, take-offs and approaches are conducted independently and virtually simultaneously on their respective runways. The average IFR (instrument weather) capacity for this configuration is estimated at 65 operations per hour, which is just short of the theoretical rate.

Effects of jet blast and fuel spillage on bituminous pavements were discussed by W. J. Turnbull and Charles R. Foster, respectively, chief of the Soils Di-

Trip to New York International Airport was one of the highlights of the conference. Here interested group of engineers inspects operation of radar controls of the Civil Aeronautics Administration, explained by Joseph D. Blatt, conference chairman.

vision, and chief of the Flexible Pavement Branch of the Soils Division of the Waterways Experiment Station at Vicksburg. Results of tests and observations made to date were summarized as follows:

Jet blast is critical for hot-mix asphaltic-concrete pavements only at the ends of runways and on aprons where maintenance "run-ups" are made. The effect of jet blast in other areas (taxiways and runways except the ends) is not detrimental to hot-mix asphaltic-concrete pavement.

Critical erosion temperatures of bituminous-concrete pavements subjected to heat and blast are in the order of 250 deg F. for tar, 300 deg F. for asphaltic-concrete pavements, and 315 deg F. for rubberized tar concrete pavements. Pavement temperatures developed by most of the U. S. Air Force planes operating today are less than 300 deg F. except when after-burners are used.

Occasional spillage of jet fuel on dense, hot-mix asphaltic-concrete pavement is not detrimental. Repeated spillage, such as that occurring on parking and refueling aprons is detrimental because the fuel leaches the asphalt cement from the aggregate. The areas affected are relatively small. A pavement resistant to jet fuels is necessary in these areas. Rubberized-tar concrete pavements are jet-fuel resistant and have given reasonably satisfactory performance. The effects of aging are not known.

Pavement problems of the U.S. Air Force in the jet age were discussed by George W. Leslie, consulting civil engineer, Directorate of Construction, U.S. Air Force. Experience has shown the Air Force that jet engines dump fuel when they are shut-off or decelerated. Repeated fuel spillage quickly dissolves the asphalt binder and the pavement disintegrates. Such areas exposed to traffic and blast soon become damaged. Runway ends are quickly burned and eroded by hot jet blasts. Loose pavement particles, resulting from this action, are a hazard to jet engines.

Mr. Leslie commented that there are certain facts that cannot be ignored: "Pavements must be unaffected by the solvent action of jet fuels. They must be heat resistant to withstand the hot, high velocity exhaust of jet engines. They have to be abrasion resistant, durable, and structurally adequate to support heavy wheel loads, and to withstand high unit contact pressures and high frequency loadings. Based upon his experience with design, construction and service behavior of airfield pavements the Air Force has concluded that these requirements can be most nearly met by the use of portland cement concrete. To alleviate the dust problem and the spread of debris on the pavements, shoulders adjacent to taxiways, aprons, warm-up pads and areas at runway ends must be stabilized with an erosion-resistant surface.

Military aircraft, different from commercial jets, put a 240,000-lb load on a twin landing gear on pavement designed for 100,000-lb loads. How long pavements will hold up under this B-52 traffic is not certain. There is no doubt that commercial jet aircraft will continue to get heavier. And, unless the aircraft designer is careful, there will be few present-day commercial airports capable of supporting the heavier craft.

Attesting to the wide interest in the conference was the presence of representatives from overseas, the International Civil Aviation Organization, the International Air Transport Association, and similar groups. There was a registered attendance of 248. Mr. Blatt was chairman of the conference committee. Vice-chairmen were Reginald J. Sutherland, of New York, and Prof. Robert Horonjeff, of Berkeley, Calif.

ASCE Prizes and Awards are Announced by Board

On recommendation of the Committee on Society Prizes, the Board at its Buffalo meeting approved the following 1957 prizes for papers published in Volume 121 of TRANSACTIONS and in CIVIL ENGINEERING. Presentation will be made at ceremonies held during the Annual Convention in New York in October. Further details, together with brief biographies, will appear in a later issue of CIVIL ENGINEERING.

Norman Medal

ALFRED M. FREUDENTHAL, M. ASCE, for Paper, "Safety and the Probability of Structural Failure."

J. James R. Croes Medal

WILLIAM E. WAGNER, M. ASCE, for Paper, "Determination of Pressure-Controlled Profiles."

Thomas Fitch Rowland Prize

HARRY N. HILL, M. ASCE; ERNEST C. HARTMANN, M. ASCE; and JOHN W. CLARK, J.M. ASCE, for Paper, "Design of Aluminum Alloy Beam-Columns."

James Laurie Prize

WALTER L. DICKEY, M. ASCE, and GLENN B. WOODRUFF, M. ASCE, for Paper, "The Vibrations of Steel Stacks."

Arthur M. Wellington Prize

WESLEY G. HOLTZ, M. ASCE, and HAROLD J. GIBBS, A.M. ASCE, for Paper, "Engineering Properties of Expansive Clays."

Collingwood Prize for Junior Members

GEORGE E. MACDONALD, A.M. ASCE, for Paper, "Surveys and Maps for Pipe Lines."

Ernest E. Howard Award

WILLIAM ENNELS DEAN, JR., M. ASCE, of Tallahassee, Fla., for his outstanding contribution and pioneer work in the design and use of prestressed and post-tension reinforced concrete, particularly as related to work in bridge construction.

On recommendation of the Technical Division Prize Committees, the Board approved the following awards:

J. C. Stevens Award

NEAL E. MINSHALL, A.M. ASCE, for discussion of the Paper, "The Box Inlet Spillway and Its Outlet."

Rudolph Hering Medal

ALFRED C. INGERSOLL, A.M. ASCE; JACK E. MCKEE, M. ASCE; and NORMAN H. BROOKS, J.M. ASCE, for Paper, "Fundamental Concepts of Rectangular Settling Tanks."

Leon S. Moisseiff Award

DAVID J. PEERY, for Paper, "An Influence Line Analysis for Suspension Bridges."

James W. Rickey Medal

CARLO SEMENZA, M. ASCE, and CLAUDIO MARCELLO, M. ASCE, both of Italy, for contributing "in an important manner to the science of progress of hydroelectric engineering."

Middlebrooks Award

CHARLES I. MANSUR, M. ASCE, and JOHN A. FOCHT, JR., A.M. ASCE, for Paper, "Pile-Loading Tests, Morganza Floodway Control Structure."

Karl Emil Hilgard Hydraulics Prize

DONALD ROSS, for Paper, "A Physical Approach to Turbulent Boundary-Layer Problems."

Construction Engineering Prize

JOHN N. NEWELL, M. ASCE, for article in May 1956 issue of CIVIL ENGINEERING, "Pneumatic Caisson Pier for World's Longest Pipeline Suspension Bridge."

ASCE Completes Survey of Engineers' Salaries

ASCE Committee on Salaries

Donald H. Mattern, Chairman
Warren W. Parks, Vice-Chairman
DeWitt C. Greer
Oscar S. Bray
Graham P. Willoughby

The 1957 report of the Society's Committee on Salaries constitutes the fourth in the biennial series of salary surveys conducted by the Committee. Consonant with its purpose as stated in the By-Laws of the Society to ". . . collect, codify and prepare for distribution such data as may be calculated to be of value to employers of civil engineers and to civil engineering employees in connection with the proper classification of engineering positions and equitable compensation for such services," the Committee here presents [an abstract of] the results of its 1957 survey.

Since the 1955 Salary Survey, engineering salaries have shown a marked increase. As in previous years, the greatest percentage increases were recorded in the lower professional grades. Unlike previous years, however, the percentage increases remain relatively high up through Grade VIII (Fig. 1). The range is from about 20 percent for Grade I to about 14 percent for Grade VIII. This is an indication that the pressures producing the upward trend of salaries, originally felt only in the immediate postgraduation levels, are now being felt throughout the entire salary scale. It is to be noted that the national average entrance rate to Grade I shows the greatest two-year increase in dollars since the Survey began (Fig. 2).

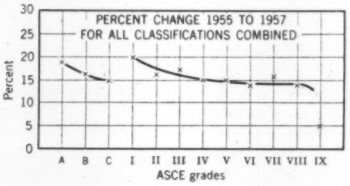


Fig. 1

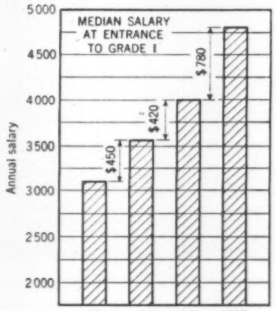
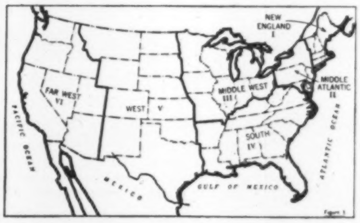


Fig. 2



The pattern within the various categories of professional practice does not follow, however. While the increases shown in the consulting field generally parallel the national averages, those recorded in the municipal and county field climb sharply in the higher grades. On the other hand, upper grades in the construction, state highway, railroad, utility and industrial fields show increases of much lower order of magnitude than the lower grades.

Preprofessional

In the preprofessional grades the results vary considerably between areas of employment. Among construction firms, the increases shown for Grades A, B, and C were the highest of all grades. For consulting firms the percent increases for these grades were on a par with the professional grades. In all other categories the increases for the preprofessionals were lower than those shown for the initial professional grades. In the combined national figure, the increases for Grades A, B, and C were equal in magnitude to the increases of Grades I, II, and III (Fig. 1).

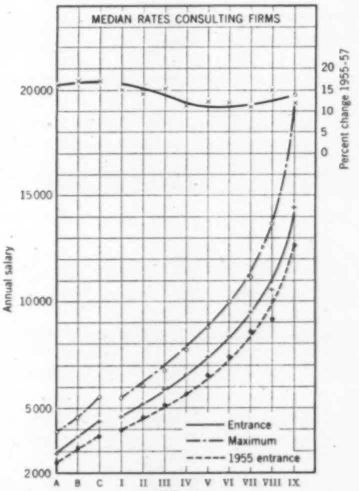


Fig. 4

Educational Field

Educational institutions showed percentage increases slightly lower than other areas of professional practice. They ranged from about 15 percent for the instructor grade to about 10 percent for heads of departments, Fig. 9. These percentages were based on salary rates adjusted to an eleven-month basis. No attempt was made to evaluate additional income from consulting, research, or other extracurricular sources.

Basis of Survey

As in previous surveys returns were classified in six categories of professional activity. These are:

1. Consulting firms
2. Contracting firms

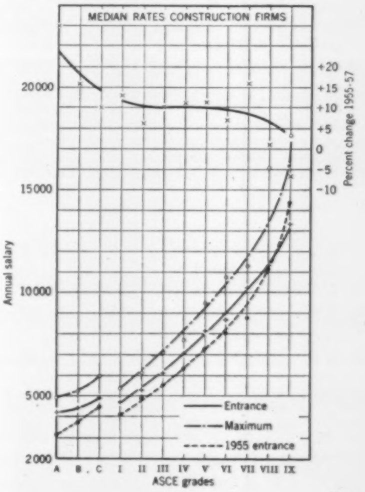


Fig. 5

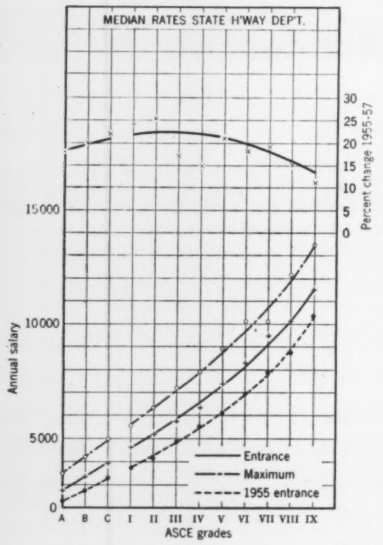


Fig. 6

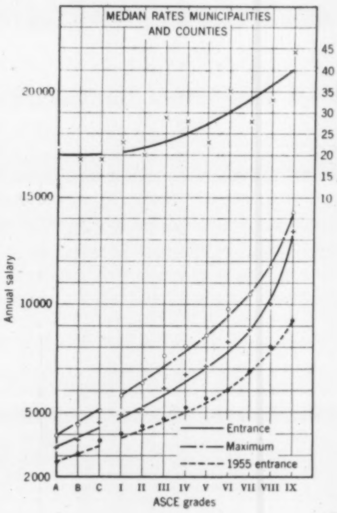


Fig. 7

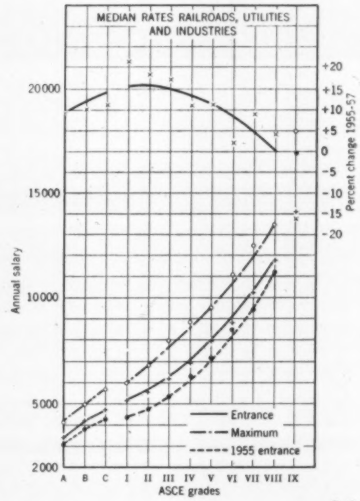


Fig. 8

Curves are not extended through Grade IX because of lack of statistical data for this grade.

3. State highway departments
4. Municipalities and counties
5. Educational institutions
6. Railroads, utilities, industries

No replies were solicited from federal agencies since the Civil Service salary scale generally reflects federal salaries throughout the country. The Federal Salary Rates for Civil Service (GS grades) are shown in Fig. 10, where they are compared with ASCE's grades according to Classification of Civil Engineering Positions. Figs. 4 to 9 compare median entrance rates found in the 1955 survey with the median entrance and median maximum rates in these six categories found in the 1957 survey. The median is that figure having 50 percent of the replies lower, and 50 percent higher.

Inquiries were sent out to 877 organizations, and returns were received from 297 of them. The distribution by category is as follows:

	No. of Organizations		No. of Engineering Employees	
Consulting firms	87		5,331	
Construction firms	31		551	
Railroads, utilities and industries	44		4,404	
Total—private organizations		162		10,286
State highway departments	35		34,635	
Other governmental agencies	9		1,078	
Total—public agencies		44		35,713
Educational institutions	91		1,717	
		91		1,717
Grand total		297		47,716

The return of 34 percent compares to a return of 38 percent in the 1955 Survey. The number of employees represented by the responding organizations, 47,716, is comparable to the 57,186 employees represented in the previous report. While the returns do not entirely duplicate the organizations reporting in 1955, the overlap is great enough to warrant the comparisons made.

Fringe Benefits

Fringe benefits (vacation and sick leave, bonus and profit-sharing plans, retirement, health and life insurance plans), while of material value to an employee are difficult to evaluate. The figures did indicate that the fringe benefits roughly amounted to about 15 percent of the annual salary rate shown in the curves.

The committee is grateful to all who supplied basic data for this report. It is hoped that the report will prove as useful as the substantial response to the previous reports has indicated them to be. Issuance of the next Survey is planned for 1959.

[Members wishing the complete text and tabulations of the report may obtain a copy by addressing the Executive Secretary.]

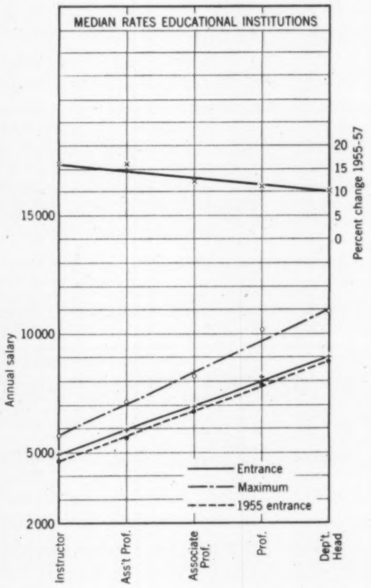


Fig. 9

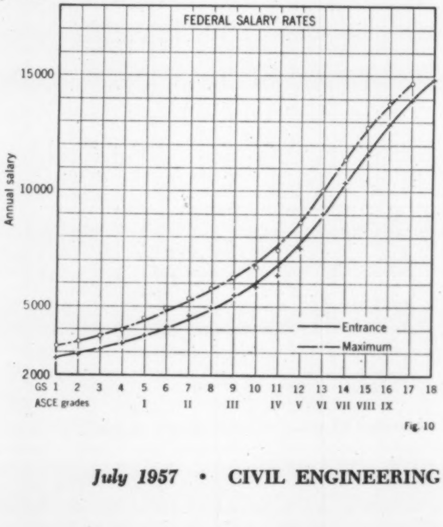


Fig. 10

Proposal for Classification of Members

ASCE Task Committee on Classification of Members

Frank L. Weaver, Chairman
Don M. Corbett
Randle B. Alexander
Clarence L. Eckel
William S. LaLonde
Mason C. Prichard
John P. Riley
Thomas C. Shedd
Lowber D. Snow
Graham P. Willoughby

The interim report to the Board of Direction was received by the Board at its meeting in Buffalo, June 3-4, 1957. The Board instructed that it be printed and submitted for the review and comments of the membership of the Society through the Local Sections. Local Sections have been requested to make their comments to the Executive Secretary not later than October 1, 1957, so that the Task Committee's final report can be considered by the Board at its meeting scheduled for February 24 and 25, 1958. The report follows.

The Task Committee on Classification of Members presents herewith its report and recommendations. Authorized by the Board of Direction on October 16, 1956, the Committee was directed "to continue the study of membership grades and requirements and to present recommendations to the Board within one year. . . ." Amendments to the ASCE Constitution which would be necessary to implement the recommendations of the Task Committee have been prepared by the Committee.

The appointment of the Task Committee followed immediately a preliminary investigation—made by the 1956 Committee on Membership Qualifications and presented to the Board at the Annual Convention in October 1956—and President Lockwood's analysis of a canvass of Local Section officers during the summer of 1956 for their views on Society affairs, including membership grades.

The Task Committee, in its study of the problem, gave consideration to the material mentioned above. It also reviewed the Dean Edwards committee report of 1948, which analyzed a questionnaire that was circulated to the Society membership, and which recommended changes in membership grades. No action was taken by the Board in the direction of adopting those recommendations. Attention was also given to the 1949 Report of the Committee on Professional Recognition of Engineers Council for Professional Development, which contained recommendations "with respect to uniform membership grades and qualifications . . ." Recommendations of the ASCE Committee favorable to adoption of the ECPD report were tabled by the Board early in 1950. Finally, the studies of the current Task Committee included the membership grades and qualifications of the other major engineering societies.

The Task Committee held meetings, aggregating four days, in January, February, and April, with virtually full attendance at all meetings. Consisting of ten members scattered over the United States and with a background of years of ASCE activity, the Committee undoubtedly reflects to a very considerable extent the thinking of civil engineers in their several localities.

Objectives Defined

Early in its deliberations, the Task Committee concluded that criteria should be developed and, after consideration of the material available to it, it adopted the following as guidelines for its deliberations:

1. *Maintenance of membership standards.* There should be no watering-down or lowering of standards of any of the present engineer membership grades; rather, these standards should be raised, if this can be accomplished reasonably, in the interest of enhancing the professional standing of the Society and its members.

2. *Registration.* At the appropriate place in the specifications for membership grades, legal registration as an engineer should be a requirement. The Committee believes that, at this time, registration should be a requirement for the top membership grade only.

3. *Graduation.* Greater recognition, than is the case under the present Constitution, should be given to graduation in engineering from a school of recognized standing, by making graduation a requirement for admission to the lowest grade, but to that grade only. With this strengthening of requirements, a change should be made in the name for the entrance grade.

4. *Management positions.* Recognition of trained and experienced engineers in management positions should be further defined, with a view to reducing to a minimum involuntary separations from the Society on account of insufficient professional engineering experience to meet requirements for transfer to the next higher grade.

5. *Student relations.* The close relation of civil engineering students to the activities and operations of ASCE should be maintained and enhanced if practicable.

6. *Nomenclature.* Consistent with the aforestated criteria, the name designations for membership grades should parallel as closely as possible those used by the majority of the Founder Engineer societies and recommended in the ECPD report.

Grades Renamed

The Task Committee on Classification of Members believes that the proposed amendments to the Constitution accomplish the above objectives. The major recommendation is that the Society continue its basic three-grade membership classification with new name designations as follows:

1. *Senior Member.* This grade would take the place of the present Member grade, but would differ from it in these main respects: (*a*) minimum age would be increased from 35 to 40 years; (*b*) minimum years of responsible charge would be increased from

five to eight years; (*c*) legal registration as an engineer would be a requirement for membership in the grade; and (*d*) admission would be only by transfer from the grade of Member after not less than five years of responsible charge of important engineering work in the grade of Member.

The Committee considers a classification of Fellow to have and to imply honorary status, and prefers the classification of Senior Member as one that is dignified, not too laudatory, in line with the common use of the term "senior partner", and a working classification for which the membership may apply when qualified.

2. *Member.* This grade would take the place of the present Associate Member grade, but would differ from it in these main respects: (*a*) minimum age would be increased from 25 to 27 years; and (*b*) minimum years of responsible charge would be increased from one to three years. Membership would be by advancement from the grade of Associate Member or by direct admission, and in this respect there would be no change from present requirements.

3. *Associate Member.* This grade would take the place of the present Junior Member grade, but would differ from it in these main respects: (*a*) there would be no minimum age requirement; (*b*) those who are not engineering graduates from a school of recognized standing would not be eligible for admission at this grade; and (*c*) transfer to another grade instead of being mandatory at age 32 would be mandatory 12 years after receiving a bachelor's degree in engineering unless, as now, an extension is granted for military service.

If these proposed amendments are approved by the Board of Direction and by the Membership of the Society, then to accomplish the change, all Members, Associate Members, and Junior Members at the time of final approval would automatically have the names of their membership grades changed respectively to Senior Member, Member, and Associate Member.

There are undoubtedly a large number of engineers who are now in the present Associate Member grade and who are well qualified under present rules for our present Member grade, but who have never taken the trouble to apply for transfer. The Task Committee believes that those who are in Associate Member grade at the time of adoption of these proposed amendments to the Constitution should be granted a grace period of six months in which they could apply for advancement under present rules.

The Task Committee makes a similar recommendation with respect to those who are now in Junior Member grade.

All applications received from nonmembers should be considered in accordance with the proposed provisions of the Constitution except for those received prior to the date of adoption of the amendments.

Student Chapter Members

At the beginning of its deliberations the Committee was favorably inclined to the often expressed view that the classification of Member of a Student Chapter should be changed to a new Student Member Classification. To assist the Committee in its deliberations, Executive Secretary Wisely presented an analysis which showed that a much higher percentage of students graduating in civil engineering join ASCE than is correspondingly the case with the other Founder Societies. The Task Committee recommends that the present system of membership in Student Chapters be continued.

Mr. Wisely presented an analysis of membership losses for the three-year period, 1954-1956. His analysis shows that while the loss from the entrance (now Junior Member) grade was 8.4 percent, it was only 1.5 percent from all the other grades combined. This loss is less than the corresponding loss in any other Founder Society. A substantial part of the loss from entrance grade results from the fact that many in this grade have developed specific pursuits not of sufficient engineering character and responsible charge nor of sufficient attainment in management, sales, administrative, or promotional activities to warrant their advancement to the next higher grade. Under the present Constitution these members must be dropped from the Society.

Affiliate Grade

With a view to remedying this situation, in part at least, the Committee recommends changes in the requirements for Affiliate grade, whereby, among other changes, the minimum age limit would be lowered from 35 to 27, and the years of responsible charge in an applicant's special pursuit would be lowered from five to three years. The new requirements would be of a standard comparable with those recommended for the new Member grade. If these new requirements for membership in Affiliate grade are adopted, it is believed that many members in the entrance grade who now must be dropped because of inability to advance to the next higher grade will find it possible and desirable to continue their membership in ASCE in the new Affiliate grade. Except for present Affiliates, an Affiliate would not have the right to vote or to hold office.

Honorary Members

The Committee does not recommend any changes in the qualifications for Honorary Membership. It does recommend, however, that the limit on the total number of Honorary Members presently set to not exceed one for every 750 members be removed, but the provision that the number elected in any year shall not exceed one for every 7,500 members be retained. The limitation of one to 7,500 appears to offer all of the selectivity needed to retain the distinction of this grade.

Fees and Dues

Entrance fees would be as follows:

Associate Member	$10.00
Member	25.00
Affiliate	25.00

However, there would be no entrance fee for the new Associate Member grade for graduates who have been members of Student Chapters and who apply within 60 days after graduation, and there would be no fee for transfer between grades.

Annual dues would be:

Associate Member —	
First seven years after graduation	$15.00
Thereafter	25.00
Member	25.00
Senior Member	25.00
Affiliate	25.00

An analysis by the staff of the financial impact of all the recommended amendments indicates that there probably would be some small net increase in annual income to the Society.

The Committee hopes and believes that under the recommended amendments to the Constitution those admitted to the Society would be better qualified; that the tendency to seek transfer to higher grades before attaining the necessary qualifications would be reduced, with a lessening in the number of declinations for the highest grade and an increase in applications for and acceptance in the intermediate grade.

Finally, the Committee recommends that if the Board approves this report, the proposed amendments be presented to the membership as a package unit for one vote of Yes or No.

Louis R. Howson Is Nominated for President

Louis R. Howson, Chicago consultant and former ASCE officer, was nominated for President of the Society by the Board of Direction at its Buffalo meeting. The nomination will go to the membership for confirmation by letter ballot, and installation will take place at the Society's Annual Convention to be held in New York in October.

LOUIS R. HOWSON
Nominee for President

Mr. Howson has been connected with the firm of Alvord, Burdick & Howson since his graduation from the University of Wisconsin, and is now senior partner. A specialist in sanitary engineering, Mr. Howson has been consulted on waste disposal by the Milwaukee Sewerage Commission, the Toronto Metropolitan Commission, and numerous other municipalities. He was chief sanitary expert for New York, Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota on four U. S. Supreme Court hearings relating to diversion and sewage treatment at Chicago. He has also been adviser on water supply to many large cities, including New York and Chicago, and to the Atomic Energy Commission.

Becoming an Associate Member in 1914 and Member in 1922, Mr. Howson has served the Society in many capacities. He was Director from 1949 to 1953, and Vice-President in 1955 and 1956.

ASCE Membership as of June 10, 1957

Members	9,532
Associate Members	12,832
Junior Members	17,471
Affiliates	74
Honorary Members	42
Total	39,951
(June 8, 1956	39,140)

Division Doings

Highway Division Endorses BPR Design Standards

The Geometric Design Standards for the National System of Interstate and Defense Highways have been endorsed by two committees of the Highway Division—the Committee on Geometrics of Highway Design and the Division's Executive Committee.

The design standards were adopted by the American Association of State Highway Officials and approved by the U. S. Bureau of Public Roads in mid-1956. While specific in nature, they are considered as minimum standards. The preface to the standards states, "It is expected that designs will generally be made to values as high as are commensurate with conditions, and values near the minimums herein will be used in design only where the higher values will result in excessive cost."

In endorsing the standards, the Executive Committee expressed the opinion that they "represent a very significant step in the development of nationwide standards for principal highways." Because of the widespread effect and influence on allied engineering fields, the Committee stressed the need for general understanding by all civil engineers of the application of the standards.

According to the standards, "the National System of Interstate and Defense Highways is the most important in the United States, and will carry more traffic per mile than any other comparable national system. . . . They must be designed with control of access to insure their safety, permanence, and utility."

The current basic minimum rural standards are briefed here:

Two-lane highways should be designed so that slow-moving vehicles can be passed easily and safely. Divided highways will be designed and located as two separate one-way roads, each taking advantage of the terrain, with median strip in flat and rolling areas at least 36 ft wide.

Initial construction must provide features required to meet 1975 traffic, based on peak-hour traffic "as high as the 30th highest hourly volume in the year 1975," referred to as the design hourly volume, "DHV (1975)".

No railroad crossings at grade will be permitted, and all at-grade intersections with public and private roads must be eliminated except where there is insufficient traffic to create an appreciable hazard.

Roads in the system will provide for speeds of 70 mph in flat country where grades are less than 3 percent. For more mountainous terrain and on grades up to 5 percent the design speed will be 50 mph. In unusually rugged topography gradients up to 7 percent can be used.

Each traffic lane will be at least 12 ft wide. A normal criterion is that where the DHV (1975) exceeds 700 the highway will be divided. Climbing lanes on upgrades for slow-moving vehicles will improve the capacity and efficiency of two-lane highways. Shoulders capable of use by all classes of traffic in all weather must be provided along the right of traffic.

Bridges and overpasses up to 150 ft in length, deck construction preferred, must be as wide as the full roadway including its usable shoulders.

Copies of the standards may be obtained from the U. S. Department of Commerce, Bureau of Public Roads, Washington 25, D. C.

Structural Division Organizes Digital Computer Committee

In keeping with current interest in digital computers as one means of lightening the work load in the highway departments, the Structural Division has organized a Committee on Digital Computers. In addition to relieving engineers of routine and laborious computations, the new committee is aimed at "improving design by incorporating refined procedures and methods not otherwise practical . . . , and correlating work done in the structural engineering field with that being done in other fields of engineering."

It is hoped that, through the committee, the Structural Division membership can be kept up to date on new uses for high-speed computing machines. Committee personnel will be announced later.

Task Force on Aerated Flow in Open Channel Meets

Late in May the Task Force on Aerated Flow in Open Channels met at the St. Anthony Falls Hydraulic Laboratory in Minneapolis. Dr. Lorenz G.

Straub, director of the Laboratory, was host to the group, which was set up by the Hydraulics Division's Committee on Research. The group inspected the elaborate equipment that has been developed at the Laboratory for the study of entrained air in steep chutes.

A major objective of the task force will be to find a solution to the problem of bulking of flow from entrained air and the necessary height of side walls in steep chutes. The literature on both laboratory and field research will be reviewed, and a report issued.

Prof. W. W. DeLapp, of the University of Colorado, heads the task force, which also includes Prof. A. G. Anderson, of the University of Minnesota; W. J. Bauer, of the Meissner Engineering Corp., Chicago; and D. Colgate, of the Bureau of Reclamation, Denver. Contact member with the Hydraulics Division's Committee on Research is F. B. Campbell, of the Waterways Experiment Station.

Power Division Makes Annual Convention Plans

The Power Division is readying a symposium on underground hydroelectric power plants for the Annual Convention, to be held in New York this fall. The symposium will feature six papers by eminent engineers—two from the United States and one each from Canada, Sweden, Switzerland, and Yugoslavia.

Intersociety Conference on Irrigation and Drainage

Can man develop a permanent irrigation agriculture? Answers to this question formed the theme of the First Intersociety Conference on Irrigation and Drainage held in San Francisco, April 29 and 30. Sponsored jointly by the ASCE Irrigation and Drainage Division and divisions of the American Society of Agricultural Engineers and the Soil Science Society of America, the conference was widely acclaimed as a first joint attempt to solve problems involved in the vital subject of water in agriculture.

Featured speakers included specialists in irrigation and allied subjects from four University of California campuses. Approaches to the problem of conflicting demands for water were presented in a leading paper by Samuel B. Morris, M. ASCE, Los Angeles consultant. The ever-increasing need for teamwork in the solution of water problems was played up in another important paper by Harvey O. Banks, M. ASCE, California director of water resources. University participants included Prof. (emeritus) Frank J. Veihmeyer, speaking on crop selection for water deficient areas, and Asst. Prof. Robert H. Burgy, dealing with watershed vegetation management. Wide newspapers publicity was given a government researcher's report that "he is almost ready to introduce a perennial wheat." Coit A. Suneson, research economist for the Department of Agriculture, said that commercial farm production of this "literally new crop" is no more than three to five years in the future.

Harry F. Blaney, chairman of the executive committee of the Irrigation and Drainage Division, was conference chairman. The program committee was headed by Prof. Robert M. Hagan, of the Davis campus of the University of California.

Problems of Instability Studied at Column Research Parley

Problems involving instability of structural trusses and frames were discussed at the annual conference of the Column Research Council held on the Lehigh University campus in May. The Council is an Engineering Foundation project under sponsorship of ASCE.

The major emphasis of the technical session, attended by nearly 100 educators, research specialists, and engineers, was toward relating known information to the writing of appropriate specification clauses. Presenting papers were Paul P. Bijlaard, M. ASCE, professor of structural engineering at Cornell University; Thomas C. Kavanagh, M. ASCE, of Praeger and Kavanagh, consulting engineers, New York, N. Y.; and Robert L. Ketter, J.M. ASCE, assistant professor of civil engineering at Lehigh.

Dr. Bijlaard spoke on results obtained in a Cornell project concerned with methods for calculating the critical load of a truss and eccentric buckling of elastically restricted columns. He also reviewed results of his work on several closely related subjects, such as plastic buckling of plates and buckling of latticed columns.

In a paper entitled "Effective Length of Columns," Dr. Kavanagh summarized the results of research in the field conducted over the past 30 years, including recent developments under jurisdiction of the Column Research Council. He emphasized practical application of the theoretical work in terms of simplified treatments applicable to design specifications.

"Structural steel members as delivered from the rolling mill contain residual stresses due to the manner in which they cool," Dr. Ketter told the group. In his paper he presented a method for determining the strength of members containing such stresses. His presentation also emphasized the seriousness of not including residual stresses in strength calculations.

The conference also featured a buckling test on a rigid truss work model in the Fritz Engineering Laboratory.

Nicholas J. Hoff, M. ASCE, head of the department of aeronautics and mechanics at Brooklyn Polytechnic Institute, was chairman of the technical session. Bruce G. Johnston, M. ASCE, professor of structural engineering at the University of Michigan, is chairman of the Council.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

CITY	CURRENT	LAST QUARTER
Atlanta	1.10	1.10
Baltimore	1.09	1.02
Boston	1.07	1.07
Chicago	1.12	1.06
Denver	1.11	1.04
Houston	1.04	
Kansas City	1.14	1.06
Los Angeles	1.12	1.14
New Orleans	1.00	1.00
New York	1.15	1.11
Pittsburgh	1.05	1.05
Portland	1.08	1.06
San Francisco	1.13	1.09
Seattle	1.05	1.05

Highway Departments

REGION	CURRENT	LAST QUARTER
I, New England	0.80	*
II, Mid. Atlantic.	1.11	
III, Mid. West.	1.16	
IV, South	1.05	
V, West	0.93	
VI, Far West	1.06	

Figures are based on salaries in effect as of May 15, 1957. Base figure, the sum of Federal Civil Service, G.S. Grades 5, 7 and 9 for 1956, is $15,930.

*No figures are given for the last quarter in the Highway Department category because the scope of the index was widened and the figures for the two quarters are not truly comparable.

For Columbus' new expansion to 120 mgd....

Plant Manager, James H. Blodgett, and Uhlmann Associates, consulting engineers, faced tough problems in doubling the capacity of a previously expanded activated-sludge plant.

To get top plant performance, the complex instrumentation—both old and new—would have to be pulled together. Twenty year old meters would have to be modified, rebuilt, or replaced to work alongside today's improved models, telemetering total influent for the entire expanded plant to *one central control point.*

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VALVE AND METER COMPANY

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

John D. Fitch (left), prominent member of the Brazil Section and first vice-president of Companhia Auxiliar de Empresas Electricas Brasileiras, is shown at Rio de Janeiro Engineering Club, after presenting to club his collection of ASCE Transactions covering the years, 1926-1956. With him are F. Saturnino de Britto Filho (center), acting president of the club, and Nearch de Azevedo, club librarian.

FOUNDED
1852

Scene is Colorado Section's annual Junior-Student Member Meeting, featuring talk by President Mason Lockwood and presentation of awards to outstanding seniors in the three Student Chapters in the Section. Viewed, in usual order, are Richard M. Ralston, award winner for the Colorado State University Chapter; Emerson S. Ellett, vice-president of Section and chairman of its Student Affairs Committee; President Lockwood; William F. MacMillan, award winner for the Denver University Chapter; and Robert H. Taylor, award winner for the University of Colorado.

In closing days of the school year St. Louis Section was host to Student Chapters at Washington University and University of Missouri. The meeting, which honored senior civil engineers of the two universities, was one of several arranged by the Junior Members. Pictured, in usual order, are A. C. Weber, chairman of Section's Awards Committee; Carlon E. Faust, Jr., Washington University award winner; Prof. D. W. Ryckman, Faculty Adviser for the Washington University Student Chapter; John H. Endebrock, University of Missouri award winner; Prof. William Sangster, Faculty Adviser for University of Missouri Chapter; and E. L. Murer, president of St. Louis Section.

ASCE CONVENTIONS

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 14-18

CHICAGO CONVENTION
Chicago, Ill.
Sherman Hotel
February 24-28, 1958

PORTLAND CONVENTION
Portland, Ore.
Multnomah Hotel
June 23-27, 1958

TECHNICAL DIVISION MEETINGS

WORLD STRUCTURAL PRESTRESSED CONCRETE CONFERENCE
San Francisco, Calif.
Fairmont Hotel
July 29-August 2

HYDRAULICS CONFERENCE
Cambridge, Mass.
Mass. Inst. of Tech.
August 26-28

WATERWAYS & HARBORS CONFERENCE
Princeton, N. J.
October 18
(Part of Annual Convention program)

COUNCIL CONFERENCES

DISTRICT 7 COUNCIL
Grand Rapids, Minn.
North Central School of Agriculture
July 19-20
and
Local Section Conference
July 18-19

LOCAL SECTION MEETINGS

South Carolina—Annual joint summer meeting with the South Carolina Society of Engineers at Clemson College, Clemson, S. C., August 2 and 3. Clemson House will be convention headquarters. Registration will start at noon on August 2. Ladies are invited to attend.

Wisconsin—Dinner meeting at the Elks Club, Appleton, Wis., July 25, with program on the St. Lawrence Waterway; annual family picnic at Lincoln Park, Milwaukee, on August 4.

Owner: Nedmac Associates, Inc. *Architect:* Ziegler, Childs & Paulsen. *Structural Engineers:* Lars I. Moe & Son. *General Contractor:* Terminal Construction Corporation.

3,500 Tons Erected in Five Weeks With High-Strength Bolting

This is the new Parkade Building, a modern functional structure in the center of Camden, N. J. The wings and first and second floors of the center portion of the building are used for office space, while the top three floors of the center portion, plus the entire roof, are devoted to parking facilities for 1000 cars. Bethlehem High-Strength Bolts were used in joining the structural members of the 3500-ton steel framework, which was erected in less than five weeks.

Bethlehem High-Strength Bolts make possible a saving in time in erecting steelwork because they are so easy to install. Only two pieces of equipment—a holding wrench and a pneumatic impact wrench—are needed to make joints which are permanently tight.

In addition to the time-saving factor, high-strength bolting is a particularly good choice for construction in hospital and school zones, as the pneumatic wrench used for tightening is far less noisy than a riveting gun. Besides, there's no fire hazard involved, as the bolts are installed cold. Nor is there danger of injury from tossed rivets.

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BY-LINE WASHINGTON . . . . .

A proposal to extend the National Interstate System by 7,000 miles and the construction period by seven years has been approved by the Senate Subcommittee on Roads. The committee agreed an increase in federal aid would be necessary—nearly $18 billion.

Some Congressmen have repeatedly and flatly declared that additions to the system must be made. After they authorized an additional 1,000 miles above the original 40,000 network last year, numerous states submitted routes they wanted tacked onto the system. The Bureau of Public Roads was asked to approve some 12,500 miles for which Uncle Sam would pick up 90 percent of the cost.

If the additions are made it will be directly contrary to what leading highway engineers have recommended, namely that the states get well under way on the currently defined 41,000 miles before additions are considered and the financing scheme thrown out of kilter. Increased highway-user taxes would be necessary to raise the $18 billion proposed, and it is doubtful that the truckers and motorists will want to assume the additional tax burden.

* * *

Self-employed civil engineers with an interest in the Jenkins-Keogh bill, now before Congress, will be glad to hear that a cooperative push is being made to obtain its passage. The American Bar, Medical and Dental Associations, supported by other groups of self-employed persons, have joined forces under the newly formed American Thrift Assembly. The Jenkins-Keogh bill is a measure which would give self-employed men some tax incentives to provide for their own retirement plans.

Chances are dim that the bill will even reach the floor this session, however. It is strongly opposed by the Treasury Department which claims that some $225 million in tax losses would be sustained and that a measure to favor any one group at this time would open the door for a flood of other tax concessions. Actually, the American Thrift Assembly points out, not more than $41 million would be involved and the money would not be lost to the Treasury, but only deferred.

* * *

The federal government's Lease-Purchase Plan has been revived. General Services Administrator Franklin Floete told Congress last month that changed economic conditions have warranted taking the program off the shelf and again trying to obtain acceptable bids.

Three months ago GSA reported it was halting plans for construction because of high bids and the difficulty of obtaining financing money. Design work has proceeded, however, and now 98 projects, fully approved, are ready to roll. About 150 cities have projects they want developed.

The Senate Public Works Subcommittee has approved a three-year extension of the scheme, with amendments designed to make the troubled program more attractive to private investors.

* * *

Continuation of the federal urban redevelopment program was assured last month, also, when both the House and Senate voted new authorization funds. The House OK'ed $250 million for one year; the Senate specified $500 million for two years. The federal share apparently will remain at two-thirds the cost of a project. Only $173 million had been requested by the Administration, a move that sent municipal interests scurrying to Congress with pleas for more money.

Differences between the House and Senate bills are being worked out by a conference committee now, and the compromise measure may have been reported out in final form by the time this is read.

* * *

A growing concern for the improvement of construction specifications was revealed in attendance at the annual meeting of the Construction Specifications Institute in Washington last month. A growth in membership from 1,000 to 1,600 within the past year was reported. Although the Institute has been fostered mainly by architects, its growing membership includes a number of engineers. Some local chapters, where membership is predominantly men involved in heavy or highway work, are busily reviewing specifications in that field.

Some of the most stimulating thoughts of the assembly were aired by an official of a Wisconsin architect-engineering firm. Kenneth M. Wilson, of E. F. Klinger & Associates, Eau Claire, urged tight specification of materials and products by actual name of manufacturer, brand name, or catalogue number.

Following that practice has proved "conclusively" for his firm, Mr. Wilson said, that "tight specifications, combined with sharp, well-detailed drawings, are worth from $1.50 to $2.00 per sq ft of floor area on buildings in the $10 to $20 per sq-ft range." Both contractors and manufacturers bid on a closer margin when the "or equal" clause was eliminated, he asserted.

* * *

Congress is currently considering a request from the Atomic Energy Commission for more than $295 million to continue its construction activities. The agency's building program, although not so much in the news, continues to be a vital part of the nation's total construction volume. An AEC official reported last month that some 14,000 construction workers are still employed on agency projects, many of which are complex and costly. AEC construction over the past ten years has amounted to $6 billion and even now, new work is being completed at the rate of about $1 million a day.

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NEWS BRIEFS . . .

May Construction Activity at New High for Month

Outlays for new construction rose seasonally by 11 percent in May to $4 billion, a new high for the month, according to preliminary estimates of the Departments of Commerce and Labor. Activity this May brought the total for the first five months of 1957 to a record $17.1 billion, 3 percent above last year's January-May total. On a seasonally adjusted basis, new construction activity in May was at an annual rate of $46.9 billion, compared with the revised estimate of $46.1 billion spent in 1956.

The revised 1956 figure, which is considerably above last January's preliminary 1956 estimate of $44.3 billion, reflects mainly a $2.3-billion upward adjustment in the dollar value of additions and alterations to private nonfarm housing that was partially offset by a $630-million downward adjustment in highway expenditures.

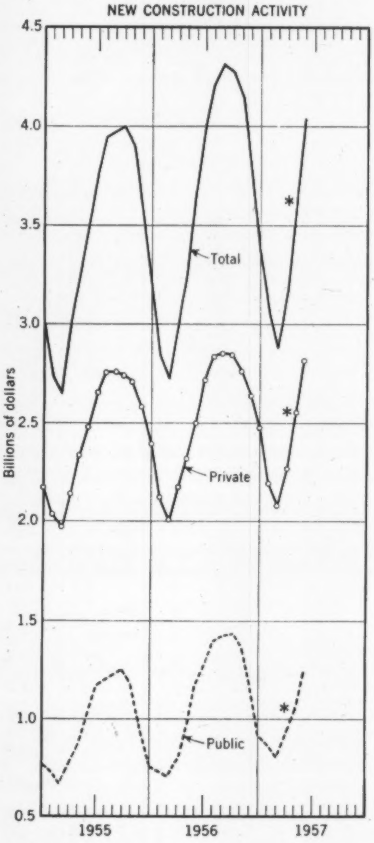
Increased spending for virtually all types of public work has been a dominant factor in keeping dollar volume this year ahead of 1956 levels for the same months. Public outlays for new construction ($1.2 billion in May and $4.8 billion for the January-May period) were 12 percent higher this year than last, when data for the first five months are compared.

So far this year important gains have also been made in all major types of private nonfarm construction except new housing and store building. Private spending for construction of utilities, industrial plants, office buildings and warehouses, most community-type facilities (churches and hospitals), and for additions and alterations to residential structures set new records in 1957 for the January-May period and showed substantial increases over May 1956. However, the drop in outlays for new dwelling units and stores offset these increases, so that 1957 private outlays just about equalled the 1956 record both for May and for the first five months.

In contrast to the 12 percent decline in new private housing activity for the first five months, outlays for additions and alterations to existing homes and for construction of motels and other nonhousekeeping residential units continued to advance strongly in 1957. Thus the value of private nonfarm residential construction as a whole, which totaled $6 billion for the January-May period, was only 7 percent below the volume for the comparable period of 1956.

Public construction outlays have been boosted so far this year by increases for highways, schools, and sewer and water facilities—virtually all of them state and locally owned. Most of the rise in highway construction has been on federally aided systems. Activity on federally owned projects also was well ahead of last year, with a decline in installations for the Air Force more than compensated for by gains in all types of public industrial building, including atomic energy facilities, conservation and development work, armed services (Capehart) housing and facilities for the Army and Navy.

Seasonal rise of 11 percent in construction activity in May brings outlays to $4 billion, a new high for the month. Total for first five months is up 3 percent over last year's January-May total.



* *Correction*

Site Excavated for Dresden Nuclear Power Station

Construction work is starting this June on the Commonwealth Edison Company's 180,000-kw Dresden Nuclear Power Station, which is being built on a site 50 miles southwest of Chicago. It will be the largest all-nuclear power plant built to date in the United States. Excavation shown here will contain the base of the 190-ft steel sphere and nuclear fuel-handling facilities. General Electric Company is building the dual-cycle boiling water reactor plant for Commonwealth Edison and the co-sponsoring Nuclear Power Group for a contract price of $45,000,000. The Bechtel Corporation is constructor-engineer on the project, which is scheduled for completion in 1960.

AWWA Holds 77th Annual Conference

Fifteen fruitful technical sessions devoted to water resources, conservation, purification, and distribution, and the administration of water works held the spotlight at the 77th annual conference of the American Water Works Association in Atlantic City, N. J., May 12-17. The attendance of 3,067 was reported to be a record. The huge municipal auditorium also housed an elaborate, attention-getting exhibition of meters, pumps, pipes, valves, chlorinators, filters, and tools and equipment used by water works men, presented by 200 exhibitors of the Water & Sewage Works Manufacturers Association.

A few of the technical subjects presented at the conference are briefed here.

Fred Merryfield (right), new president of AWWA, and W. F. Rockwell examine Rockwell Manufacturing Company's new magnetic water meter, featured at the Water and Sewage Works Manufacturers exhibit, Atlantic City.

Land Acquisition for Reservoirs

How much land should be owned or controlled for the protection of water stored in impounding reservoirs? In undertaking to answer this question, Francis S. Friel, Vice-President of ASCE and Philadelphia consultant, discovered "a singular lack of uniformity in the policies adopted by various waterworks in their land acquisition practice." The land to be taken must include, first of all, that below the maximum flood level of the reservoir, plus all needed for the dam and appurtenant works. Second, he said, it should include a marginal strip 100 ft or more in width around the reservoir beyond the maximum flood line. Third, ownership or control of the rest of the contributory watershed depends upon the topography and state of development of the land, and its value, but particularly upon the use to which the water is to be put and, if the water is for domestic use, the extent of the treatment it will receive. On the basis of records of many storage reservoirs, Mr. Friel concluded that the total land area acquired approximates 300 percent of the reservoir area at flood level where the water is filtered, although some water companies own or have control of major portions of their watersheds. If untreated or chlorinated water is delivered for use, more rigid control over the sanitation of the area is needed than if it is filtered.

In discussing Mr. Friel's presentation, E. Sherman Chase, M. ASCE, partner in the Boston firm of Metcalf and Eddy, commented that the advent of chlorination has modified the need for complete acquisition and control of watersheds. "Conservative New England engineers," he said, "nevertheless prefer to manage their water supply areas on the truth of the slogan that 'Innocence is better than repentance.'"

Recreational Use of Watersheds

To what extent should the public be given access to impounding reservoirs? This question was a logical one. In one answer Daniel P. Morse, of the Indianapolis Water Company, told how fishing, sailing, and motorboating are permitted and successfully controlled on two large reservoirs of this company. Noting that public access to reservoirs may result in public excesses, he pointed out that the water from both reservoirs flows in the open channel of the river for 16 to 25 miles to the intake of a plant where it is given a complete treatment.

Public pressure for recreational use of reservoirs is very great, particularly in inland areas, John McFarland, of the East Bay Municipal Utility District, Oakland, Calif., noted. His company permits no access to its 35,000 acres of watershed mostly owned by the District. For this reason the audience was not surprised to hear him say that he hoped no copies of Mr. Morse's paper would reach areas west of the Rocky Mountains. Many water works men present seemed to agree with this view.

Fresh Water from Saline Water

"Water is worth what it costs to replace it," David Jenkins, director of saline water research for the Department of the Interior, told the conference. With the present state of our knowledge and equipment, it is cheaper to make use of water before it is wasted to the sea than to reclaim fresh water from the sea after it gets there. Within the next 5 to 15 years the cost of conversion may become low enough so that many industries, some municipalities, and a few agricultural projects can afford to pay for it. Separation by freezing, he stated, is being developed and may result in the lowest cost of all processes so far tested. New approaches are needed; new ideas will be welcomed by the Department.

Control of Evaporation from Reservoirs

Monomolecular layers of hexadecanol have been consistently found to be the best performers in reducing evaporation from reservoirs, according to tests being conducted by the U. S. Bureau of Reclamation, under the direction of Lloyd O. Timblin, Jr. The tests show that this film can reduce evaporation up to 64 percent. The film persists during waves and winds, and even after rain. This chemical is not deleterious to humans, fish, aquatic plants, or insects. A full-scale operation of reducing evaporation is to be made on Lake Hefner, Oklahoma City, as soon as techniques for applying and maintaining the hexadeconal film are better developed.

Cleaning and Relining Water Mains

Norfolk, Va., faced with the problem of whether to replace its cast-iron water mains, or to rehabilitate the system, decided upon centrifugally applied cement mortar lining. Relining experiments began in 1947, R. W. Fitzgerald, superintendent of the Norfolk water supply, reported. These tests indicated that cleaning and lining with centrifugally placed mortar cost about a third of replacement costs.

In Cleveland the most economical solution for relining pipe was found to be electrophoratic deposition of bitumen for mains under 16-in. dia, and cement lining, centrifugally applied, for larger mains. These conclusions were reported by Frank J. Schwemler, Cleveland's commissioner of water and heat.

State Water Plan for New Jersey

Robert B. Meyner, governor of New Jersey, revealed to the conference his state's plan for building reservoirs on the watershed of the Raritan River to meet the fast-growing demands of users in the state, and to raise the low flow of the river to a safer figure. New Jersey has been in the business of supplying water from the Delaware and Raritan Canal since 1940.

The state-owned plan recommended by consulting engineers Whitman, Requardt and Associates, Baltimore, for developing the Raritan River basin involves, first, the 10-billion-gallon Spruce Run Reservoir and, second, the 10-billion-gallon Stony Brook Reservoir. When available, the state will sell untreated water at the river's edge to any user wishing to take it. Spruce Run Dam could begin to supply water in about three years.

National Water Policy

Reviewing a quarter century of efforts to get Congress to adopt a uniformly applied and equitable water policy for the United States, Abel Wolman, M. ASCE, Johns Hopkins University professor and sanitary consultant, expressed pessimism about translating the dozen reports from engineers and commissions into a usable guide. With his intimate connection with this background, Dr. Wolman could say that the EJC report of 1951 had special significance because it represented the unpaid contribution of 80 professional engineers, acknowledged experts. (For the 1957 report of the EJC Board of Review, see the May issue of CIVIL ENGINEERING.) Congressional inaction would seem to Dr. Wolman to indicate that the engineers' supposition that a national water policy is needed, must be erroneous. "If a policy is needed, why hasn't Congress wanted to act?," he asked. "Why doesn't Congress want it?" Probably because it would restrict liberty of action to make sectional choices and render political favors. Then, too, there seems to be a latent hostility to an equitable plan of financing water projects. Was the policy too soon? "Maybe," he averred. "Were the recommendations unrealistic? Some of them could be. Has the lack of an organized policy penalized the Congress? Evidently not," he noted.

State Water Plan for California

"Water resources are out of balance in California, geographically as well as seasonally," said Mercel J. Shelton, M. ASCE, deputy director of water resources. As an example he noted that the Eel River in a recent flood poured a million acre-feet of water into the sea in a 24-hour period; eight months later the river was so low that water had to be hauled from other sources for domestic use. Two-thirds of the water resources of the state lie in the northern one-third of the state; two-thirds of the requirements for water lie in the southern one-third. The multi-billion-dollar California Water Plan includes construction of 260 dams and reservoirs, the first unit of which is a 700-ft, 14,000,000-cu yd dam on the Feather River near Oroville, about 75 miles north of Sacramento. Cost of this first unit will be $400,000,000. Bids were taken on May 15 for preliminary work on relocating highways and railroads around the dam and reservoir. The $1½ billion Feather River Project includes 570 miles of conduit which will conduct 2,500 cfs of water in a southerly direction through the San Joaquin Valley—over, through, or around the Tehachapi Mountains—into Southern California as far south as San Diego. This puts the state in the water business for the first time.

Awards and Officers

At the Awards Reception four distinguished engineers received honorary memberships in the AWWA: C. H. Capen, New Jersey; S. Logan Kerr, Pennsylvania; W. A. Kunigk, Washington; and A. E. Berry, Canada. The first three are long-time members of ASCE. The Management Division Award went to Louis R. Howson, nominee for President of ASCE and partner in the Chicago consulting firm of Alvord, Burdick and Howson.

Fred Merryfield, M. ASCE, professor of sanitary engineering at Oregon State College, Corvallis, is the new president of the AWWA, taking over from Paul Weir, of Atlanta. Professor Merryfield, an RAF pilot in World War I, 1923 graduate of Oregon State College, staff officer in the Southwest Pacific in World War II, and member of the Oregon State Water Resources Board, keeps himself and his students abreast of the profession by practicing as a partner in the Corvallis consulting firm of Cornell, Howland, Hayes and Merryfield.

The association's new vice-president is Lewis S. Finch, M. ASCE, vice-president and chief engineer for the Indianapolis Water Company. William J. Orchard assumed office as treasurer, taking over from W. W. Brush, M. ASCE, who retired this year after 35 years as an officer of the AWWA. Harry E. Jordan, Aff. ASCE, continues as secretary. The next conference will be held in Dallas, Tex., April 20-25, 1958.

Massachusetts Turnpike Is Opened to Traffic

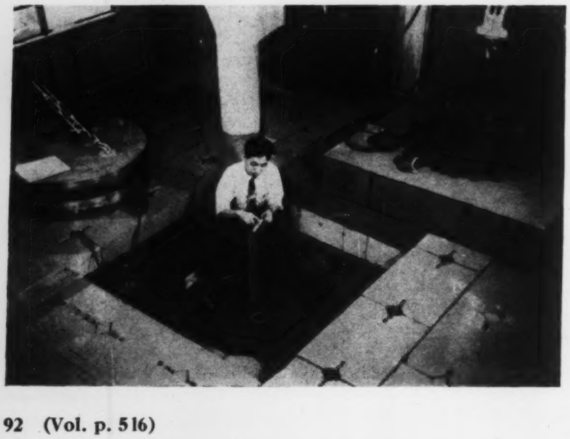
Official opening of the Massachusetts Turnpike, on May 15, gives New England another limited-access toll road. The 123-mile road starts at Route 128 on the western outskirts of Boston and continues westward in a gentle curve across the state to the New York State line at West Stockbridge. Construction of a connection between the western terminus and the New York State Thruway at Austerlitz, N. Y., is under way at present. Another link taking the eastern end of the road into Boston (a distance of 10 miles) is planned.

Tolls collected, ranging from 2 to 5½ cents a mile, will be used toward retiring $239,000,000 in construction bonds.

Symposium on Saline Water Conversion Slated

An International Symposium on Saline Water Conversion is planned for early in November, under sponsorship of the Office of Saline Water of the Department of the Interior and the National Research Council of the National Academy of Sciences. The objective of the meeting, to be held in Washington D. C., is to bring together on an international scale active workers in the field of converting saline water for agricultural, municipal and industrial uses. The three-day program will cover power distillation, electrodialysis, osmosis, solar distillation, freezing, and other scientific approaches to the problem.

Exact dates and other details will be available later this summer. Inquiries should be addressed to the Division of Physical Sciences, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington 25, D. C.



Argonne Laboratory Installs Training Reactor

Low-cost educational reactor, called the Argonaut, is in operation at the Argonne National Laboratory, Lemont, Ill., where it will be used for research and training. The experimental unit went critical during dedication of the Argonne's Experimental Boiling Water Reactor, the nation's first plant-size power reactor. The Argonaut is expected to be as important in the area of nuclear education as the EBWR is in the field of nuclear power. Its safety features and simplicity make it particularly suitable for training work. The Argonaut is designed to operate at an intermittent power development of 10 kw. Photo shows an attendant checking the fuel plates. Both the interior and outer shield plugs have been removed.

Paving Bid for AASHO Road Test Rejected

Construction has been resumed at the AASHO Road Test site at Ottawa, Ill., after being halted since last November. Initially the goal of this year's construction program was completion of the project's six test loops and related facilities so that test traffic can start in the fall. However, rejection of the single bid of $6,622,514 offered for paving the six test loops will make it impossible to complete construction of the project in time to cure the pavements and install the necessary recording instruments before winter.

According to Fred Burggraf, director of the Highway Research Board, which is administering and supervising the test for the American Association of State Highway Officials, it will now be "necessary to chart a new course and set new target dates for the completion of construction and the start of test traffic." The revised target date for the start of testing is Sepember 1958. It is planned to advertise as soon as possible for a revised contract, or contracts, splitting the construction into several phases.

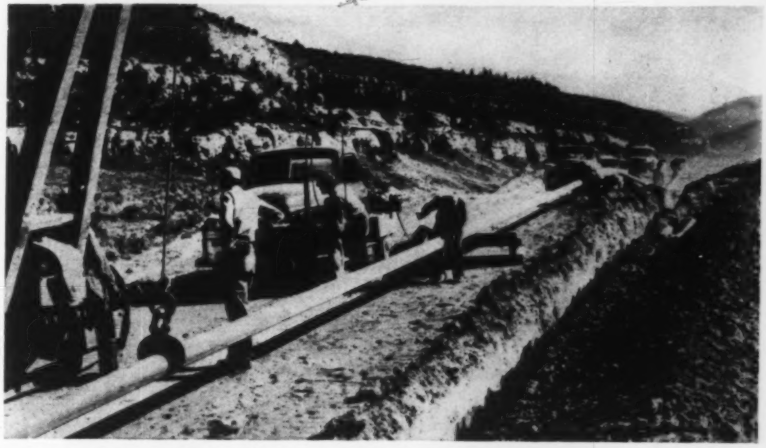
Final cost of the highway test project, the largest ever undertaken, will be in the neighobrhood of $20,000,000. Early stages of this new project were described in an article in the December 1956 issue, and the embankment compaction is the subject of an article in the current issue.

Prestressed Concrete Bridge To Cross Lake Maracaibo

This summer the Government of Venezuela is beginning work on a 5½-mile-long prestressed concrete bridge across the narrows of Lake Maracaibo. The $98,784,041 project will connect the rich oil fields on the eastern shore of the lake with Maracaibo, Venezuela's second city. It will feature a 1,312-ft center span, the longest single prestressed concrete span built to date. The center span will consist of two cable-supported concrete cantilevers, with a 230-ft concrete span suspended between them. Concrete towers, 390 ft tall, carry the supporting cables, which will be encased in concrete. The center span will be 152 ft above the water in order not to interfere with shipping. Scheduled for completion in 1960, the bridge will span the new $45,000,000 Maracaibo Channel, which has just opened the fabulous oil region to ocean traffic. It will provide for both rail and highway transportation.

Venezuelan and German companies are financing the toll structure, which is expected to pay for itself in seven years. The project will replace an inadequate ferry system which is slowing up oil shipments. It will be built by the Venezuelan firm of Precomprimido C. A. and Associates.

72-Mile Pipeline Carries Ore from Mine to Refinery



This recently completed 72-mile, 6-in. pipeline is carrying a mixture of crushed Gilsonite ore and water from the mines of the American Gilsonite Company at Bonanza, Utah, to the company's new refinery at Gilsonite (near Grand Junction), Colo., where the slurry will be converted into high-grade metallurgical coke and gasoline. The line crosses some of the most rugged terrain of the West, including Book Cliff Mountains. It is buried 3½ ft below the frost line, except in crossings of the White River and Evacuation Wash Canyon, where it is carried on 600- and 700-ft suspension bridges. Built at a cost of $2,000,000, the pipeline will save several dollars per ton over trucking costs. Its capacity is 700 tons a day.

Ground Broken for California's Feather River Project

A blast touched off by Governor Goodwin J. Knight of California on June 1 moved the first "dirt" to symbolize the start of construction of the state's $1½ billion Feather River Project. The big project is based on a 730-ft-high concrete dam on the river, 5 miles above Oroville, which will contain 14 million cubic yards of concrete.

Before work on the dam can start late in 1959, 27 miles of the Western Pacific Railroad and 20 miles of US 40-A, the Feather River Highway, must be relocated around the dam and the reservoir behind it. Included also in the preliminary work are relocations of logging railroads, county roads, canals, and utilities.

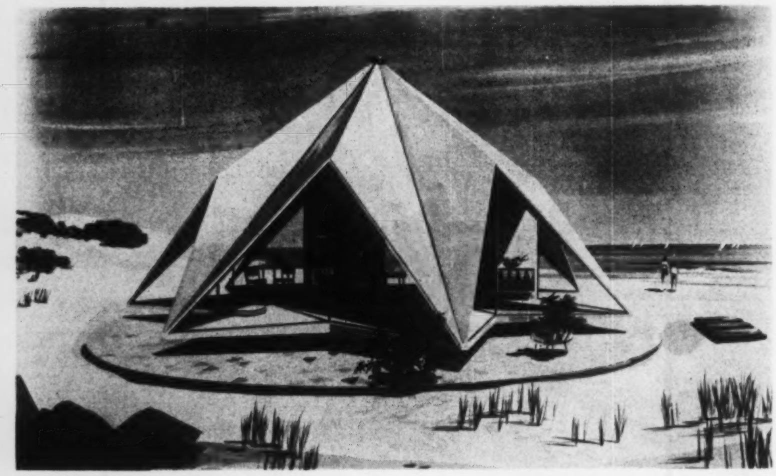
On May 17 Harvey O. Banks, M. ASCE, director of water resources of California, announced the award of a contract to Peter Kiewit Sons' Company for the construction of two major tunnels for the relocation of the Western Pacific Railroad, for the sum of $8,499,235. The tunnels, located near Big Bend, have a total length of 13,000 ft.

On May 29, Director of Public Works Frank B. Durkee awarded a contract to McCammon-Wunderlich Co. and Wunderlich Contracting Co., for $7,292,214 for the realignment of US 40-A. This contract includes grading and surfacing 13.3 miles of new highway and grading 2.6 miles of railroad roadbed between Wick's Corner and Jarbo Gap. Four bridges will be built under this contract.

Contracts for three more railroad tunnels during 1957, and for a combination railroad and highway bridge over the West Branch of the Feather River during 1958 are scheduled for bids next. The combination bridge will be a double-decked continuous steel-truss with four lanes of highway on the upper deck and a single track railroad on the lower deck. The main span is to be 576 ft with two side spans of 432 ft and one approach span of 360 ft on the south end of the 1,800-ft structure. The top of the tallest of the three main piers will be 240 ft above ground level, and the highway deck 470 ft above stream bed. When the reservoir is full the highway deck still will be 100 ft above reservoir level.

With this key dam at Oroville, California embarks on a project which will stop floods, and store water and transport it from Oroville to a terminus near San Diego nearly 700 miles away. A 260-page report, entitled Bulletin No. 3, "The California Water Plan," tells how California proposes to redistribute all its water resources. An article by Mercel J. Shelton M. ASCE, deputy director of water resources, and Fred J. Groat, supervising electric utilities engineer on the power development aspects of the California Water Plan—estimated at 1¾ billion kwhr per year at the Feather River Dam alone—is scheduled for publication in an early issue of CIVIL ENGINEERING.

Turntable-Mounted Beach House Follows the Sun



Beach house of glass and aluminum—designed for Aluminum Company of America's "Forecast" program of aluminum design—is mounted on a rotating 37-ft-dia turntable, enabling occupants to follow or escape the sun. Built around a central aluminum column, the beach house features a peaked aluminum roof (15½ ft above the floor at the peak) and glass walls that swing open to provide complete access to the outdoors. The structure includes a living room, kitchen and dining areas, three bedrooms, and bath. Harrison & Abramovitz are the designers.

Continuous Reinforced Concrete Highway Laid

Test panel of continuous reinforced concrete highway is laid at Hamburg, Pa., in experiment aimed at increasing the smoothness of concrete highways. Engineers believe that by using additional quantities of reinforcing steel the contraction joints that make for bumpy riding can be eliminated. The test, which may revolutionize highway construction, is the result of a joint research project conducted by Lehigh University, the American Iron and Steel Institute, the Pennsylvania Department of Highways, and the Bureau of Public Roads. Mat bars at extreme left were fabricated by Bethlehem Steel.

Aleutians to Have Radar Warning System

Construction machinery has moved into a desolate 1,000-mile stretch of Aleutian Island beaches, where the Army Corps of Engineers will build six radar warning stations. Designated Operation Stretchout, the project extends the Army's system of distant early warning stations (the Dew-Line) far out in the Pacific along the Aleutian chain—in areas deserted since the construction days of World War II. The stations will be spaced out between Port Heiden on the Alaska Peninsula to Nikolski on Umnak Island, more than 900 miles south and west of Anchorage, Alaska.

Moving west from the mainland of Alaska, the new Dew-Line stations will be: Port Heiden, to be built by Chris Berg, Inc., of Seattle, under a $3,548,190 contract; Port Moller, to be built by S. S. Mullen Company, Inc., of Seattle, under a $4,010,000 contract; Cold Bay and Cape Sarichef, both to be built by Manson-Osberg, also of Seattle, with a total contract of $7,246,724; Driftwood Bay, a joint venture of the Patti-McDonald Construction Company of St. Louis, Mo., and Morrison-Knudsen, of Boise, Idaho, for $4,915,052; and the Nikolski Station, to be built by the Baker and Ford Company, of Bellingham, Wash., for $4,643,647. The contracts were awarded this spring on a competitive-bid basis.

James L. McNamara, who has been in Alaska since 1938, has been appointed acting resident engineer in charge of the project for the Alaska District. Capt. Alfred J. Rabogliatti will be assistant resident engineer. Headquarters for the project will be at Cold Bay.

TV Program for Engineers

Engineers who missed the dramatic TV program, "The Mountain That Moved," at its first showing last December, will have another chance to see it over the ABC network on July 23, at 9:30 p.m. (PDT and EDT) or 8:30 p.m. (other time zones).

The teleplay—produced as one of the Telephone Time series—tells the story of a contractor who staked his career to save a million dollars in crops for Colorado farmers, when the irrigation tunnel connecting the Colorado River with Grand Valley collapsed on March 8, 1950. Hundreds of farmers faced ruin unless the tunnel could be back in service by early May. After 15 firms had refused the job, B. A. Peters accepted the challenge, risking all his capital and his career to finish the job on time. The story of the incredible obstacles Mr. Peters had to overcome in finishing the job for the Bureau of Reclamation on April 27, well ahead of the deadline, is the subject of the absorbing program.

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"Where's Joe tonite," wondered the Professor, just loud enuf for everybody to hear.

"Probably flunked the sequel 7-yr drought problem and stayed home," sneered Cal Klater.

"Yes and nope," announced the secretary. "Just had this wire: DUSTVALE, TEXHOMARADO, JUN 1 1957. FIELD STUDY SEVEN HYPHEN YEAR DROUGHT BACKFIRED STOP RAINED FOR FORTY FOUR DAYS COLON STILL RAINING STOP CONVINCED SEVEN HYPHEN YEAR DROUGHT IS MYTH SEMICOLON THIS ONE GOOFED AT SIX YEARS TEN MONTHS STOP TEXAHOMANS SELLING CATTLE BUYING FROGS STOP WHEN WILL RAIN STOP STOP CORRECTION INTERROGATION POINT"

"So the problem is purely academic, Cal. How often in a 68-yr record would you find a drought of 7 yr, no more no less?"

"Well, you suggested a corollary, so I generalized my previous formula to

$$P_{m,n}=\frac{n-m+2}{2^{m+1}}\quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

for the probability of a drought of m or more years in an n-yr record. In the previous problem, $m=7$, $n=37$ and $P=\frac{1}{8}$.

"For a drought of exactly m yr, we have only to subtract the probability of $m+1$ or more years to find the corollary, viz:

$$P=P_{m,n}-P_{m+1,n}$$

$$=\frac{n-m+2}{2^{m+1}}-\frac{n-m-1+2}{2^{m+1+1}}$$

$$=\frac{n-m+3}{2^{m+2}}\quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

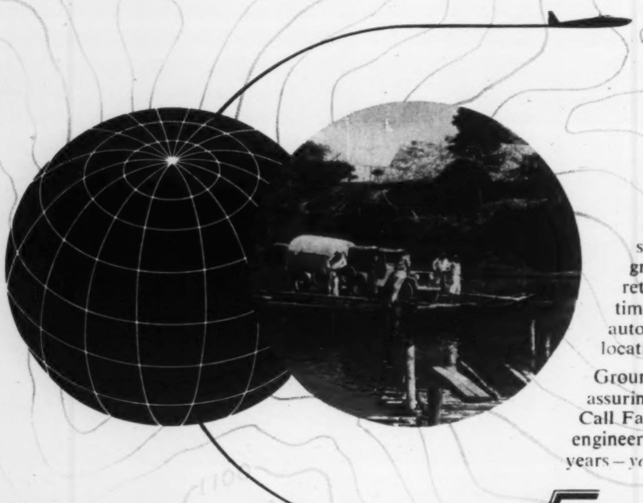
which, for $m=7$, $n=68$, gives ⅛ again."

"That's the right corollary and the right answer," agreed the Professor. It means that, on the average, one out of eight 68-yr records will have a 7-yr drought, just as the previous answer meant that one out of eight 37-yr records will have a drought of 7 *or more* years.

"I had been leading up to a super-sequel problem on the infrequency of the famous Biblical record of 7 fat years followed by 7 lean years, but the drought is over, Joe Kerr is stuck in the mud bowl, and interest of engineers has turned to the expanded highway program. It's fun to speculate on expansion, especially with an unrestricted constant rate of growth. You can figure when the oceans will be packed solid with eels. You can prove that in 2006 A.D. our Society will have 200,000 members, all living in Sacramento. Congressman Kreuger recently proved that in 2069 A.D. every citizen of the United States will be working for the government.

"Restricted growth is more realistic, as for example, if growth approaches a natural limit or point of saturation. In California, land subdivision is progressing at a rate proportional to the product of the subdivided and unsubdivided areas, increasing the subdivided area from 2 percent of the area of the state in 1947 to 3 percent now. Analogously, paving of streets and highways proceeds in proportion to product of paved and unpaved areas, increasing the paved area in the state from 1 percent in 1947 to 2 percent now. When will California be all used up?"

[*Cal Klaters were Ed C. Holt, Jr., and Rudolph W. Meyer. Also acknowledged is a solution of the April traffic problem from Thomas Morgan.*]



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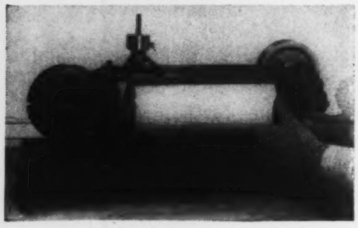

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DECEASED

Elmer Ellsworth Adams (M. '20), age 73, retired district engineer for the Great Northern Railway, Duluth, Minn., died in April. Mr. Adams joined the railway after graduating from the University of Minnesota in 1906, and remained with it until his retirement in 1953. He was resident engineer on many of the line's important development projects. Active in the Seattle Section of the Society, Mr. Adams served it as an officer at one time.

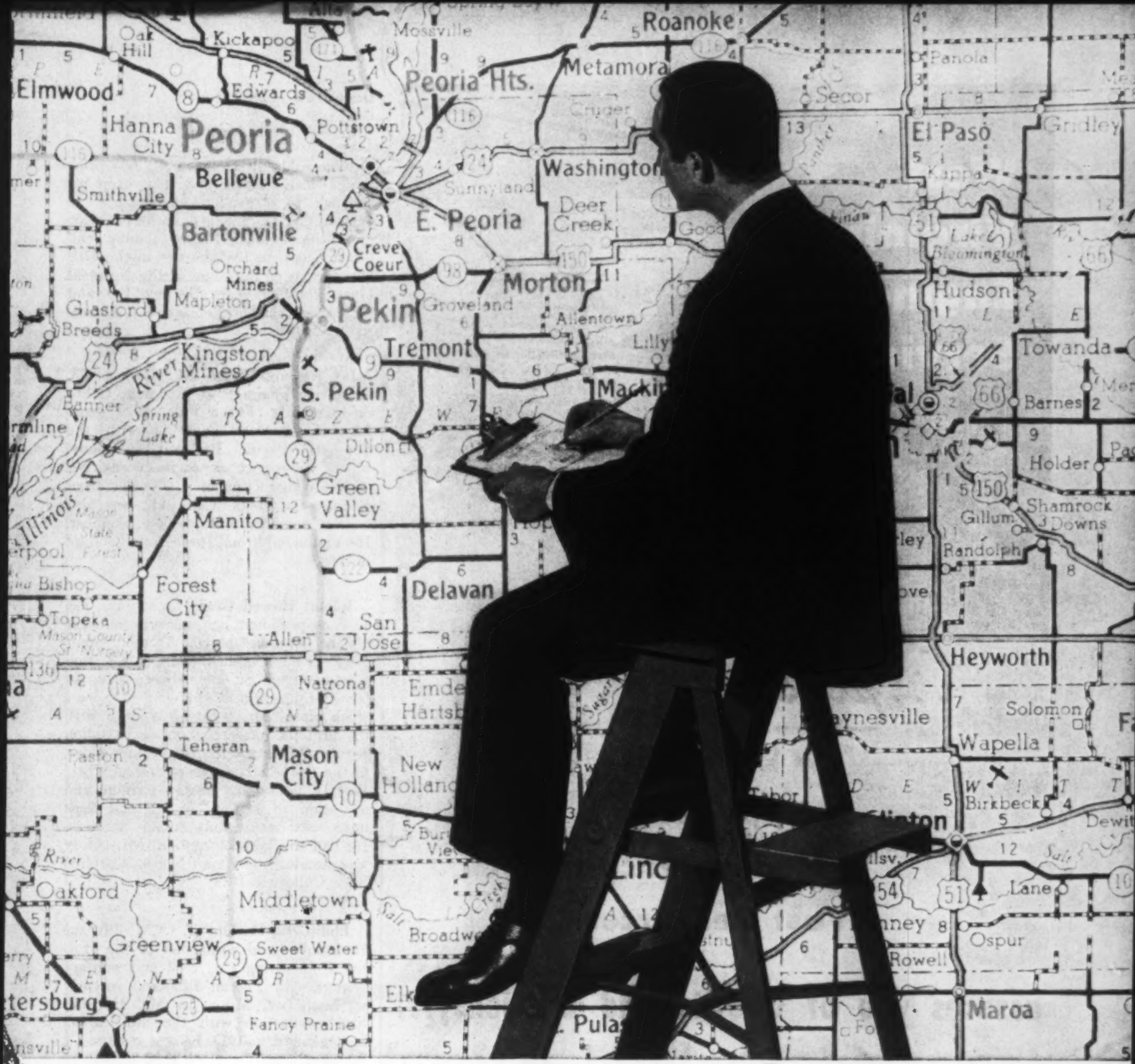
Jose Rogelio Alvarez (J.M. '52), age 26, supervising engineer for Carretera Interamericana, Panama, died recently in an airplane crash. Mr. Alvarez had been with the firm since his graduation in 1952 from the University of Santa Clara, Santa Clara, Calif.

William Godfrey Arn (M. '20), age 80, retired assistant engineer for the Illinois Central Railroad, Chicago, Ill., died recently. During Mr. Arn's 27 years with the railroad he was in charge of many important structures including the Birmingham Terminal. Earlier in his career he had been connected with the Louisville and Nashville Railroad, the Southern Bitulitic Co., and the Missouri Pacific Railroad. Mr. Arn served with the Corps of Engineers in both World Wars and held the rank of lieutenant colonel. He graduated from Rose Polytechnic Institute in 1897. He was past-president of the Illinois Section.

George H. Davis (M. '13), age 93, retired founding partner in the New York City engineering and contracting firm of Ford, Bacon and Davis, Inc., and leading public utility and transportation engineer, died in a hospital in Greenwich, Conn., on May 3. His home was in Larchmont, N. Y. Prior to his 48-year connection with the firm, he was successively vice-president and manager and president of the American Cities Railway and Light Company. A resident of New Orleans for many years, Mr. Davis supervised design and construction of electric street railways and power systems in Birmingham, Houston, Memphis and other southern cities. He also played an important part in the reconstruction of San Francisco after the earthquake of 1906. He was a graduate of Cornell University.

Vincent James Franze, Jr. (J.M. '54), age 26, Ensign, U. S. Coast and Geodetic Survey, Tampa District Office, Tampa, Fla., died recently in an automobile acci-

(Continued on page 100)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Kickapoo
Mossville
Roanoke
Elmwood
Edwards
Peoria Hts.
Metamora
Panola
Secor
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Peoria
Pottstown
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Gridley
Bellevue
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Kappa
Bartonville
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Pekin
Groveland
Allentown
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Tremont
Towanda
River
Banner
S. Pekin
Barnes
Spring Lake
Dillon
Holder
Green Valley
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Manito
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Birkbeck
Lane
Oakford
Middletown
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with a Materials Interchange Plan . . . Materials availability is a critical problem confronting highway construction authorities. At least one Midwestern state has licked this problem with a *Materials Interchange Plan* that includes Asphalt. Specifications and designs are for alternate types of construction. Roads will be built with materials available at time of construction. No redesigning and rewriting of specs. No delay in the highway building program.

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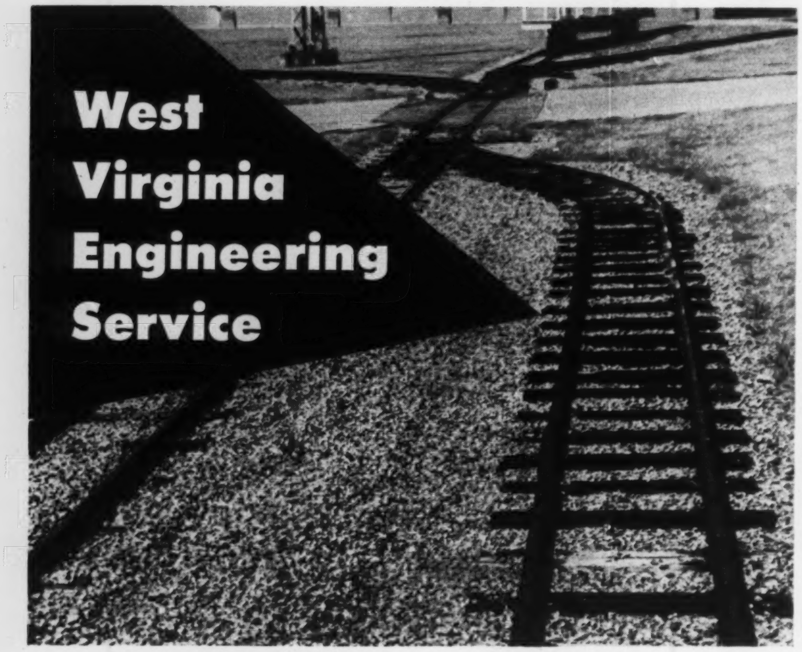

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Deceased

(Continued from page 98)

dent near Mount Holly, N. J. Just prior to his death, Mr. Franze had been reassigned to a geodetic field party at Winton, N. C., engaged in locating air navigational aids. Before joining the Coast Guard in 1955, he was in the 27th Quartermaster Battalion of the National Guard for four years. He held B.S. and M.S. degrees from Rensselaer Polytechnic Institute.

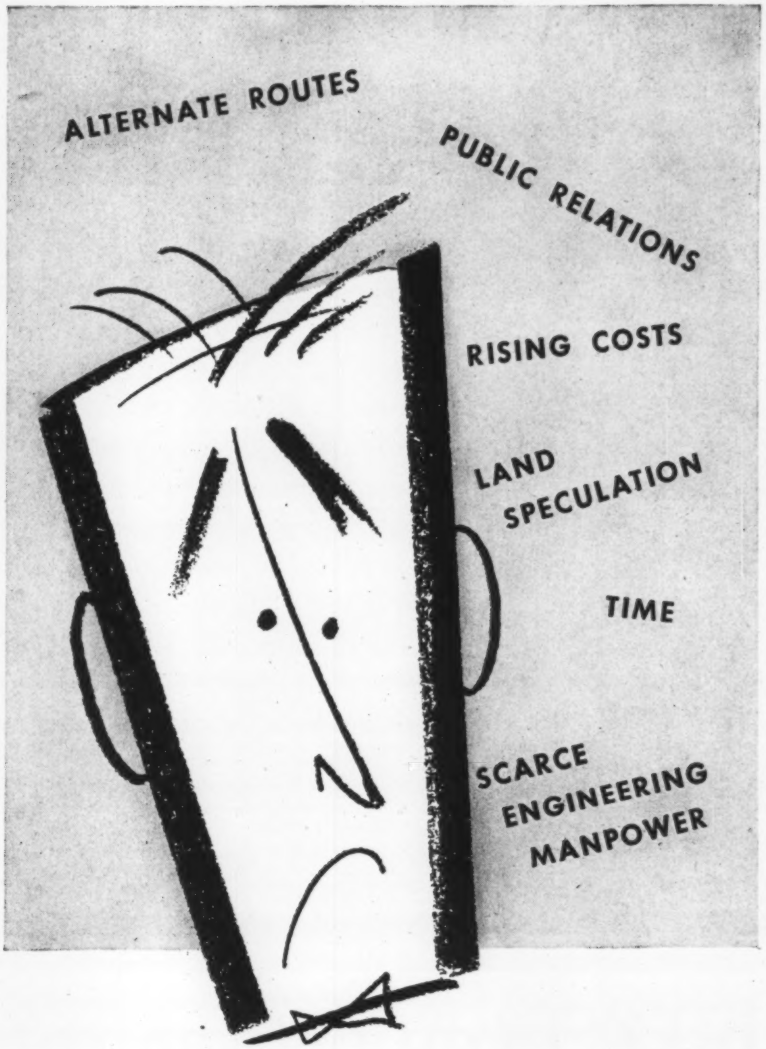
Jay Ankeny Given (M. '23), age 73, consulting engineer of Redding, Calif., died recently. For a number of years Mr. Given was connected with the Southern Pacific Railroad Company, which he served as division engineer on the construction of a new line from Redding to Delta, Calif. He was also district engineer and locating engineer. He graduated from Iowa State College in 1908.

Robert Howell Grady (A.M. '52), age 40, vice-president and general manager of the Florida-Georgia Tractor Company's Tampa branch, Tampa, Fla., and a resident of St. Petersburg, died recently from injuries suffered in a car-truck crash. Mr. Grady had been with the firm for nine years. As a Battalion Survey Officer and Battery Commander, in the Corps of Engineers during World War II, he worked on the training and operation of survey, sound, and flash units used in locating enemy artillery. He had the rank of captain. Mr. Grady was graduated from North Carolina State College in 1938.

Philip Zell Horton, Sr. (A.M. '18), age 71, founder and co-partner in the Horton Engineering Co., civil and sanitary engineers of Peoria, Ill., died recently in Rochester, Minn. In Mr. Horton's long connection with the firm, which he organized in 1913, he was responsible for many important projects. Earlier he had been with the Corps of Engineers on Ohio River work. He graduated from Cornell University in 1909.

Arthur W. Howson (M. '51), age 63, a junior partner in the firm of Alvord, Burdick & Howson, consulting engineers of Chicago, died there on June 3. Mr. Howson was a civil engineering graduate of the University of Illinois, class of 1918. He then served in World War I as a Lieutenant of Engineers. Following return to civilian life, Mr. Howson was employed by the Illinois Central Railroad as an engineer on its terminal improvement program. He remained with the Illinois Central until 1940. During this period he was active in the 108th Engineers of the 33rd Division, Illinois National Guard with which he rose progressively from the rank of Lieutenant to Colonel of the Regiment. At the beginning of World War II he was

(Continued on page 106)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RAYMOND'S important role

Development of Prestressed Concrete Cylinder Piles a boon to oil companies on Lake Maracaibo

LEFT: Giant floating rig in action at job site.

BELOW: Pre-fabricated prestressed concrete cylinder pile en route to platform location.

in the great "Oil Rush" of '57

Not since the days of Spindle Top has the world seen such an oil boom! At Lake Maracaibo, Venezuela, offshore rigs are springing up in amazing numbers, and the swish and thump of pile drivers fill the air. At this impressive, industrious exploration and drilling site, such oil giants as Shell, Mene Grande, Signal, Superior, Sun and San Jacinto have turned to Raymond to provide derrick platform foundations. The reason: Raymond's revolutionary Prestressed Concrete Cylinder Pile. This, the latest foundation development in our 60 year history, assures complete protection against the corrosive properties of Lake Maracaibo. In addition, Raymond Cylinder Piles offer greater structural strength, increased load capacities and longer life. And, thanks to a unique assembly line process, the manufacturing of cylinder piles at the job site saves time and money.

Raymond Cylinder Piles are manufactured in a series of sections placed end-to-end, which are joined by post-tensioned cables of high tensile steel wire. The sections are then grouted to form a homogeneous, impervious support of extraordinary strength and durability. To meet the demands of the new contracts, we are expanding our cylinder pile manufacturing yard, which is located right at the job site. When completed, this yard will be the largest of its type in the world!

For over 50 years, Raymond has served the oil industry, and since 1926, we have maintained a permanent office in Venezuela. You will find Raymond foundations supporting offshore drilling rigs, tanker wharves, cat-crackers and storage tanks just about everywhere oil is drilled and refined. May we also serve you?

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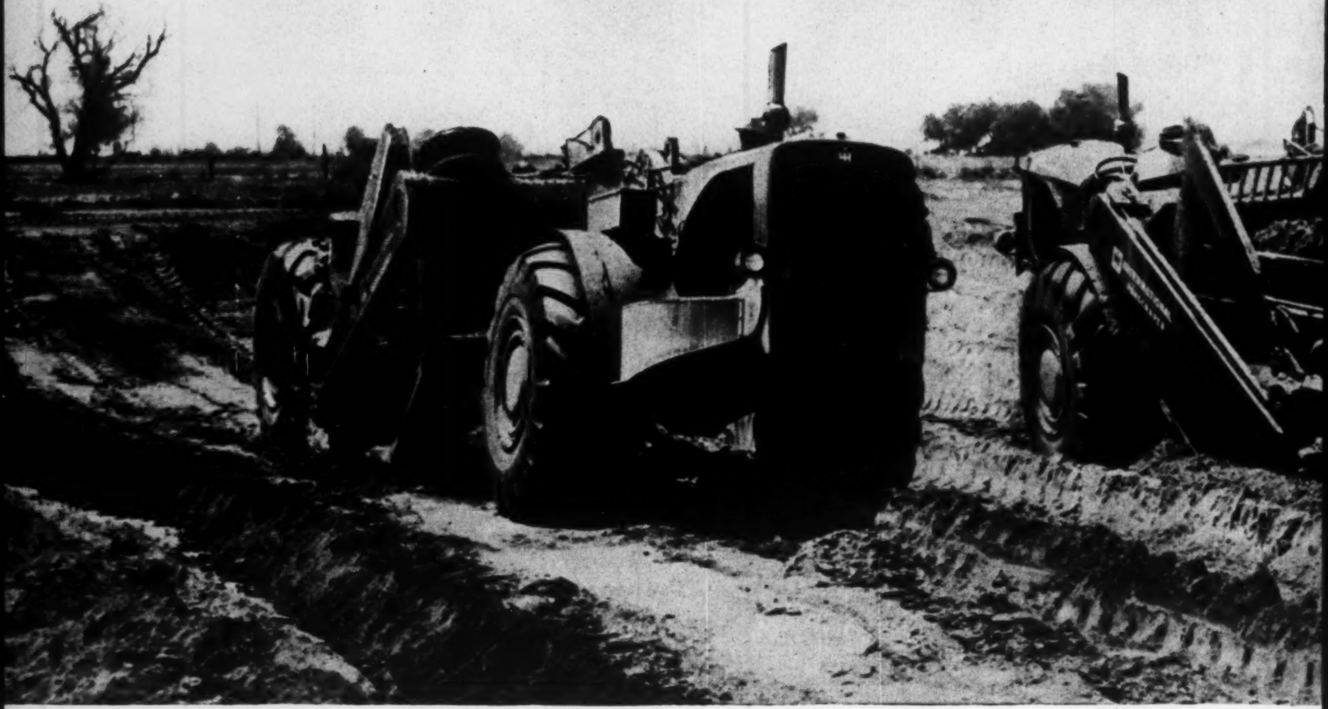
OUR 60th YEAR

How a cost-beating, can "unbind"



A TD-24 starts and gets "ready to run," seconds-fast. Morning, noon, or any other time you shut down the TD-24's diesel engine, you restart in seconds—and save yard-moving, wage-costing minutes! Exclusive International gasoline-conversion diesel starting does it—and the combustion-heated engine is ready to run as a diesel, without "gumming the works" with raw fuel!

TD-24 Cerametallic engine clutch eliminates time loss and upkeep cost of temperature-sensitive, "service-nervous" type clutches! You get the simplicity of long-familiar clutch design. You get the operating ease, temperature-immunity, and power-transfer efficiency of International Cerametallic facings. You get the instant readiness to operate perfectly when cold—plus heat-defiance for clutch-mauling jobs like 'round-the-clock shuttle-dozing.

TD-24 on-the-go shifting is a "double-barreled" cycle-speeder. The exclusive TD-24 two-speed planetary system gives instant, stall-preventing Hi-Lo shifting without declutching, in either the Torque-Converter or Gear-Drive models. And in the Gear-Drive model, you get two-direction "no-stop" shifting with exclusive synchromesh transmission.

TD-24 exclusive Planet Power steering eliminates load-limiting "dead-track drag"—gives full-time "live" profit power on both tracks. It's more than total engine hp or weight that

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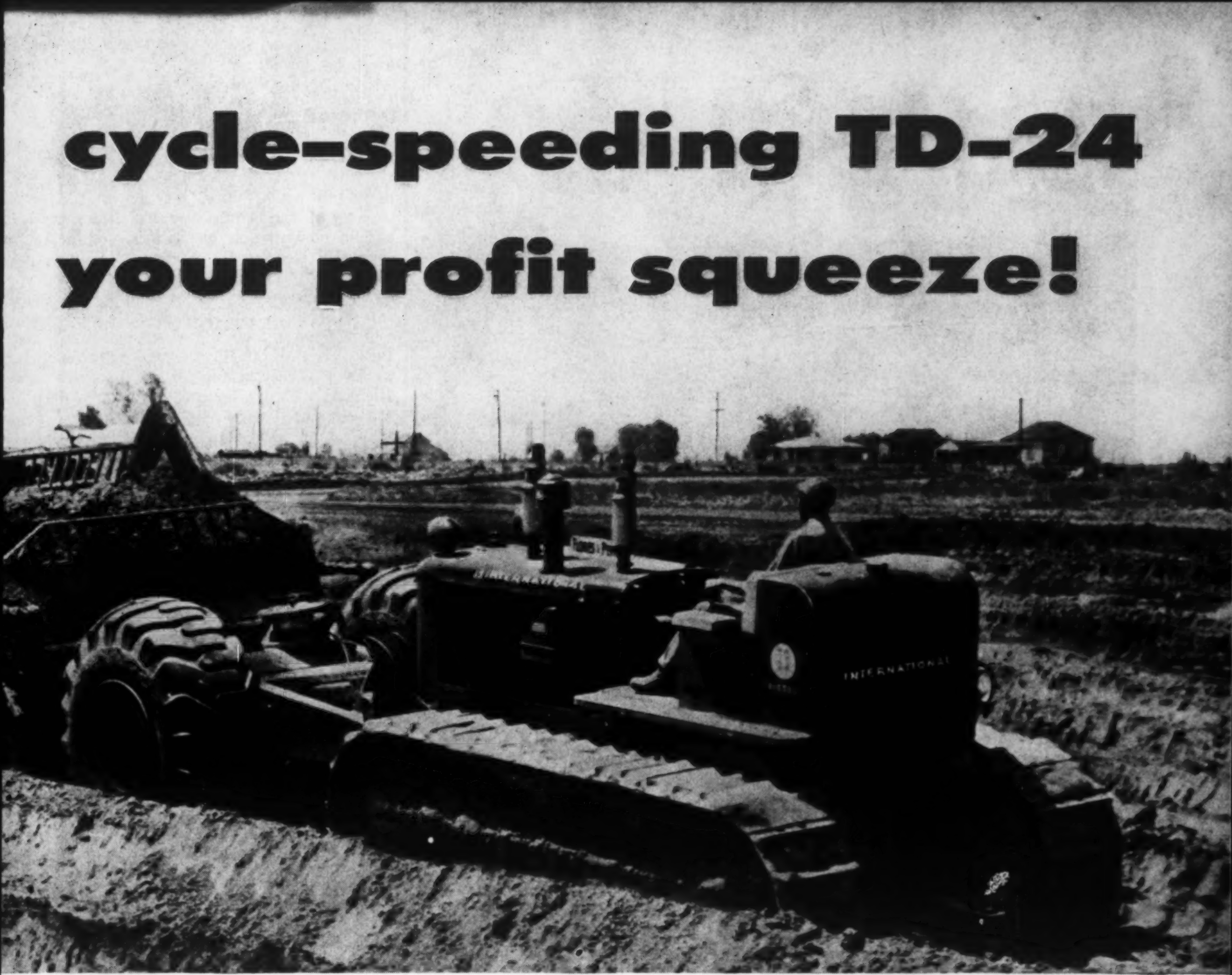
The exclusive equipment buying plan that value-measures used machinery and its components before you buy!

See VM buys now at your International Construction Equipment Distributor!

cycle-speeding TD-24 your profit squeeze!

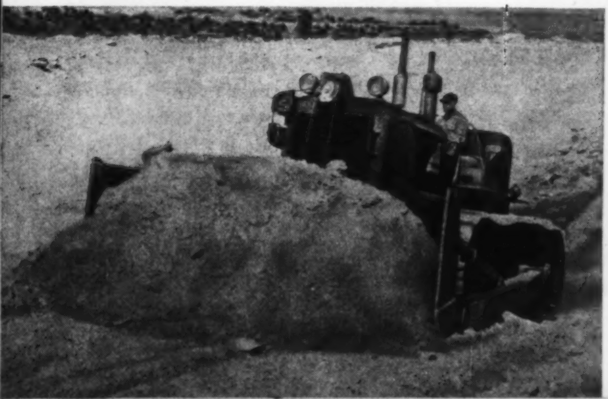


Flores and Perry, Laton, California, depend upon three International "75" Payscraper® units and a TD-24 Torque-Converter crawler—to fulfill their 8-mile grade-raising subcontract, on Central Valley Highway south of Hanford. TD-24 push helps boil-in 20 cu yd heap-loads, in only 42 seconds!

counts—watch how "dead-track drag" limits any king-sized steering-clutch crawler to what it can handle on turns. Then watch how years-proved Planet Power steering gives the TD-24 full-time, both-track power—to pull or push extra-big loads on the turns or straight ahead, uphill or down!

TD-24 control ease puts record daily production at your operator's fingertips. Cool and safe flush-deck design, control-tower vision, and reach-easy fingertip controls all increase operator comfort and performance. Never before has big crawler work-power been so load-responsive—or record work-production so easy to achieve!

Prove positively your profit-margin widens—with geared-and-steered-for-action TD-24 power giving you the success-margin of push or pull! See your International Construction Equipment Distributor for a TD-24 demonstration!



"The TD-24's 2-speed track steering holds you in 'dozing position with no slide-slip or power loss in turning," states Operator Jack Campbell for Owner J. H. Marshall, Clovis, New Mexico. The Marshall TD-24 is shown dozing tough caliche rock for road surfacing.

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Working closely with Prestressed Concrete, Inc., Florida Division's Form-Crete engineering staff supplied special mass-production steel casting side forms to produce prestressed concrete griders for supporting the roof of American Cyanamid's new triple phosphate storage plant at Brewster, Florida.

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Important as this service is, our main objective is the supplying of skillfully designed and engineered steel poured-in place and semi-portable side forms for flat bed casting. Fabricated to order, there is a Form-Crete form for virtually every standard prestressed concrete product.

Investigate this highly profitable new market—the prestressed concrete product field with its unlimited applications . . . write, wire or phone today—get into the prestressed concrete business now with FORM-CRETE steel casting forms!

These girders are 101 ft.-6 in. long with a height of 12 ft. at the center tapering to 4 ft. at the ends. Top slab width is 3 ft.—weight 71 tons.

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FORM-CRETE STEEL FORMS FOR CASTING REINFORCED OR PRESTRESSED CONCRETE

Deceased

(Continued from page 100)

called to active duty, serving in the training of engineering troops in Hawaii, airfield construction on Saipan, and in charge of clearing the harbor in Naha, Okinawa. In 1946 Mr. Howson returned to the States, becoming associated with the firm of Alvord, Burdick & Howson of which he became a junior partner in 1953. Mr. Howson supervised water works construction for the AEC at its Richland, Wash., housing project, and was associated with many other important water and sanitary projects. He was a brother of President-elect Louis R. Howson.

Royal John Mansfield (M. '17), age 79, chief engineer for the Weyerhaeuser Timber Company, Newark, N. J., died recently. In his early career Mr. Mansfield was a structural engineer with the Atlantic, Gulf and Pacific Co., in Manila, Philippine Islands, and with the Hudson Structural Steel Co., in New York, in charge of the building of theaters and loft buildings. For a number of years after that Mr. Mansfield had his own consulting practice in New York City, specializing in water supplies for sprinkler systems.

William McKinney Piatt (M. '26), age 78, for the past 14 years a partner in Piatt and Davis, Durham, N. C., died May 1. For 30 years prior to the organization of Piatt and Davis, Mr. Piatt had his own consulting and designing practice in Durham. A specialist in water and sewage treatment, Mr. Piatt had been water consultant to over 100 towns and municipalities and many agencies including the National Resources Planning Board. During World War II he was architect engineer on the construction of several Army camps. He was a Director of the Society from 1946 to 1948, and a past-president of the North Carolina Section. Mr. Piatt was educated at Lafayette College.

Kenneth William Robarts (M. '33), age 70, retired bridge engineer for the Alameda County Surveyor's Office, Oakland, Calif., died in April. During his 20-year connection with the office he served as office engineer, designing engineer, and senior civil engineer. Mr. Robarts graduated from the University of California with a B.S. degree in civil engineering.

Harry Stanley Rogers (M. '27), age 66, since 1933 president of the Polytechnic Institute of Brooklyn, died June 5 at a Brooklyn hospital. During his adminis-

(Continued on page 108)

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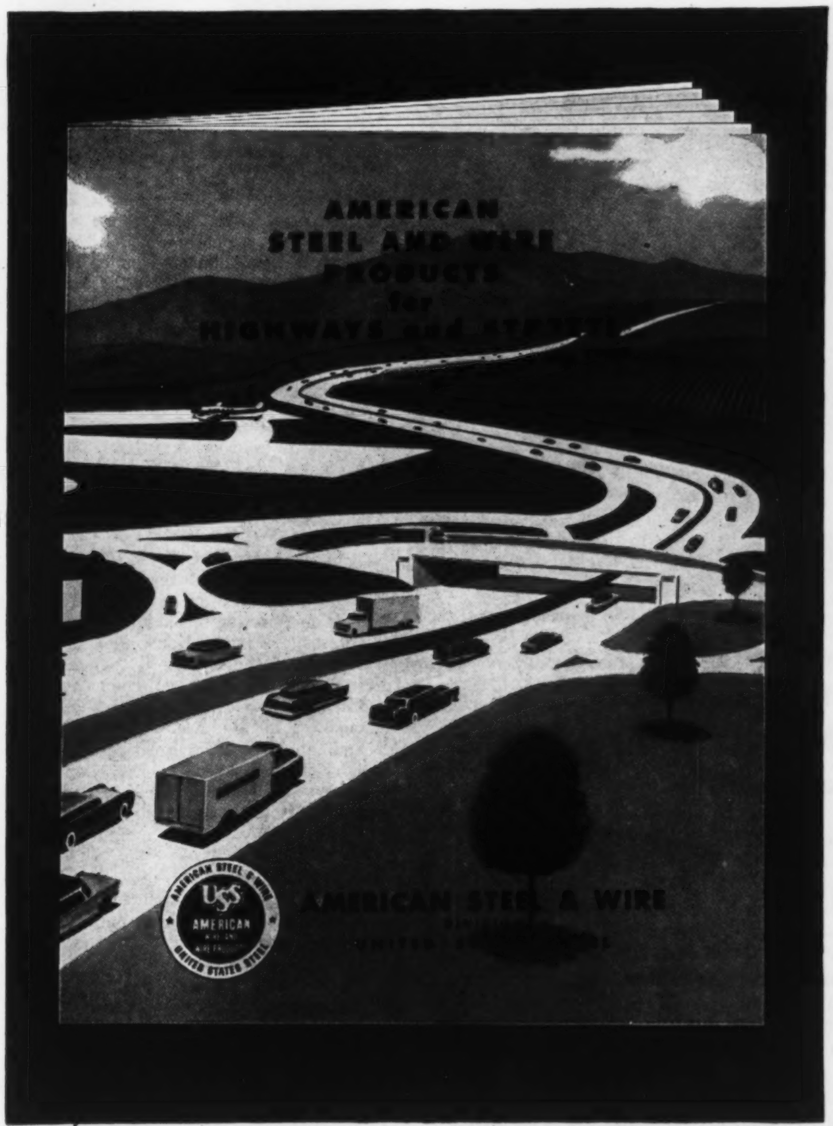
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to form voids in concrete roof slabs!

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Low-cost, easily placed
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The circular concrete roof slab for library building on the campus of the Middleville High School weighs less because it contains Sonoco SONOVOID® Fibre Tubes!

This cast-in-place slab requires less concrete and less reinforcing steel because Sonoco SONOVOID® Fibre Tubes displace low-working concrete at the neutral axis.

Voids in concrete construction save materials without impairing structural strength!

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(Continued from page 106)

tration the institute's enrollment increased from less than 2,000 to about 6,000, making it one of the largest ranking schools of science and engineering in the nation. Prior to his Polytechnic appointment, Dr. Rogers was dean of engineering at Oregon State College, director of the college's Engineering Experiment Station, and professor of hydraulics and irrigation. Dr. Rogers was active in the Engineers Council for Professional Development and the American Society for Engineering Education, both of which he served as president. He was also holder of the ASEE's Lamme Medal, presented to him "for excellence in engineering teaching." Long a leader in civic affairs, Dr. Rogers had been president of the Brooklyn Chamber of Commerce and other Brooklyn groups. He was a graduate of the University of Wyoming.

Harry S. Rogers

Frank Alden Russell (M. '24), age 77, retired chairman of the department of engineering drawing and professor of civil engineering at the University of Kansas, Lawrence, Kans., died on April 17. Dr. Russell was a faculty member from 1922 until his retirement in 1950. Earlier in his career he had been office engineer for the Kansas City Southern and the M.-K.-T. railroads. An alumnus of Kansas University, Dr. Russell received an advanced degree in civil engineering from the university in 1918.

Bernard Smith (M. '49), age 67, associate professor of civil engineering at Bucknell University, Lewisburg, Pa., and retired Colonel Army Corps of Engineers, died recently. Colonel Smith's assignments during thirty years as an Army officer included supervision of locks and dams on the Tennessee and Cumberland rivers, and training of European units for Pacific Theater service. Upon retirement from the Corps, Colonel Smith joined the faculty at Lafayette College, where he remained for five years before going to Bucknell. He was graduated from Polytechnic Institute of Brooklyn in 1914.

Bernard Smith

David Standley (M. '40), age 57, chief engineer for Drake-Merritt, of New

(Continued on page 110)

Another example of structural steel at work...strong and economical!

Mississippi Power Company Plant, Gulfport, Mississippi.

"Power House" Team for Power House (Steam)

Working as a "team," Ingalls offers specialized service in the steel fabrication, plate work and erection of every type of structure.

Here you see a 75,000 kw power house under construction for the Mississippi Power Company at Gulfport, Mississippi. Working as a team, the Ingalls Iron Works and its Birmingham Tank Division fabricated more than 2,000 tons of structural steel and plate work which was erected by Ingalls Steel Construction Company.

Ingalls has served 46 of the nation's leading power companies in 22 states. In many instances, the Ingalls plants have worked as a "team". In other instances, each plant has worked independently, furnishing either fabricated steel, plate work, or erection.

If you are contemplating a new structure, call on Ingalls—for 47 years fabricators of steel.

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HOW TO HANDLE
WET JOBS

WELLPOINTS ELIMINATE SHEETING

Harbison-Walker Brick Refractory, Hammond, Ind. — *Contractor:* Consolidated Engineering & Construction Co.

WHEN A JOB-SITE is located, like this one, in the middle of a swamp —and when the water-bearing soil is a fine sand with an underlying layer of clay — it's not surprising that the contractor should figure on sheeting. Such expense, of course, runs heavy.

• Actually, in this case—as in many others which "look like" sheeting jobs—Griffin engineers were able to solve the problem far more quickly and economically with the use of wellpoints alone. Photo shows 2-stage system which successfully drained the 27 ft of ground water as required.

• Whatever your pre-drainage problems—power plants, pipelines, buildings, etc.—if you want lower costs for lowering water, it will pay you to check with Griffin, wellpoint specialists for over 2 decades.

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(Continued from page 108)

York City, on a joint venture project in Labrador, has been declared legally dead after being lost last July in an airplane between Fox Harbor and Goose Bay, Labrador. Mr. Standley had been with the firm since 1951. For several years after his graduation from Northeastern University in 1921, Mr. Standley was an engineer with Edward and Flood, Inc., of Brooklyn, N. Y. During the war he was a lieutenant commander in the Navy Civil Engineer Corps at San Francisco, Davisville, R. I., and Gulfport, Miss.

Robert Tallmadge Stanley (A.M. '34), age 55, bridge design engineer with the Oregon State Highway Commission, Salem, died in April. Connected with the State Highway Commission since 1929, Mr. Stanley, served in various capacities including bridge draftsman and resident engineer. Earlier in his career he was associated with the Montana State Highway Commission at Helena. He was a 1926 graduate of Oregon State Agricultural College.

James Theodore Voshell (M. '13), age 82, district engineer for the U. S. Bureau of Public Roads, Chicago, Ill., died recently. Joining the BPR in 1906, Mr. Voshell devoted many years to the studying, building, and testing of various types of roads. In addition he had been in charge of all federal-aid road work in Illinois, Indiana, Kentucky and Michigan. Mr. Voshell had a B.A. degree from Indiana University and a B.S. degree in civil engineering from Purdue University.

Edward George Walker (M. '18), age 71, partner in Maxted & Knott, civil and mechanical engineers, London, England, died recently. Mr. Walker was connected with the firm for 22 years, principally in charge of cement plants. For a number of years he was consultant to the Ministry of Supply. During World War I he served in the R.A.F. as staff captain, and during World War II worked for the British government on the development of a fog dispersal plant and landing aids for aircraft. Mr. Walker was educated at Central Technology College, London.

Arthur Henry Wedge (A.M. '37), age 53, construction engineer for the Weikel Construction Co. Inc., Fort Wayne, Ind., died recently. At the outset of his career Mr. Wedge was assistant city engineer and city engineer for Wooster, Ohio, working on water and sewerage problems. Later he became city manager of Bedford, Ohio. He was the author of articles on municipal engineering and management. Mr. Wedge graduated from the College of Wooster with a B.S. degree.

George Miller Wells (M. '11), age 77, New York City consultant and one of the last of the original engineers on the construction of the Panama Canal, died on May 3. He was chief of party, assistant engineer, and office engineer in charge of design, Atlantic Division of the Panama Canal, 1904-1912; head of the Municipal Division of the Panama Canal, 1912-1914; head of the Building Division in charge of design and construction of all permanent buildings in the Canal Zone, 1914-1916. Later he was a partner in George W. Goethals and Company, New York City consulting engineers firm. For many years an executive in the chemical field, Mr. Wells had been president of the Solvay Process Company and the Semet Solvay Company. He attended the University of Washington and the Michigan College of Mines.

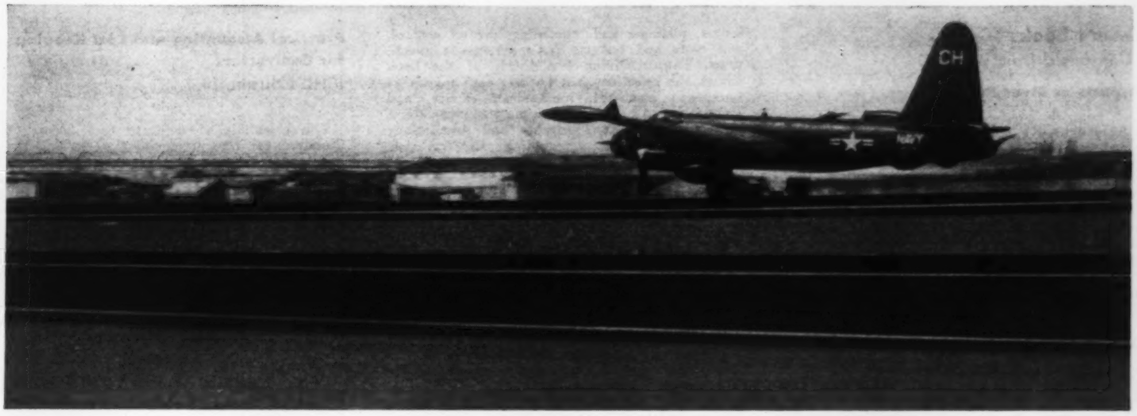
George M. Wells

Jesse E. Williams (A.M. '39), age 67, provisional adviser on highways for the Government of Colombia Ministry of Public Works, Bogota, died recently in Cuernavaca, Mexico. Prior to his appointment in Colombia, Mr. Williams had been with the U. S. Public Roads Administration (now the Bureau of Public Roads) at Denver, Colo., for over thirty years. He had been senior, division and district engineer. Mr. Williams received his B.S. degree from Colorado State College in 1912.

Jack A. Wyman (A.M. '40), age 54, architect of Omaha, Nebr., died recently. Mr. Wyman had been connected with the firms of Holmes and Narver, of Los Angeles, and Wm. J. Moran & Co., of Alhambra, Calif. At the outset of his career he was associated with the San Diego Consolidated Gas and Electric Co. Mr. Wyman graduated from the University of Illinois with a B.S. degree in architectural engineering.

Oswald Karl Yeager (M. '29), age 69, for the past seven years a consulting engineer in Phoenix, Ariz., died in March. Mr. Yeager had been engaged in various supervisory capacities with the Works Progress Administration and the Reconstruction Finance Corporation. In the early 30's he headed a construction company bearing his name in Danville, Ill.

[Editor's Note: As a result of misinformation received at Society headquarters, Howard Carter Baird (M. '04) was erroneously reported dead in the April issue. Mr. Baird, a life member and retired consultant, may be reached at 2404 Hartzell Street, Evanston, Ill. The error is sincerely regretted.]



Navy gets double savings with Bitumuls Slurry Sealing of Runways at Jet Training Station

ONE of the busiest military air installations on the entire West Coast is the Alameda Naval Air Station. In addition to heavy traffic in propeller-driven aircraft, Alameda is an important West Coast jet aircraft training center.

Runway Construction—The runways of this Naval Air Station are surfaced with asphaltic concrete, placed over a 6″ course of Bitumuls Sand Mix. The wide shoulders adjacent to these runways are also Bitumuls RS-1 Chip Seal. The surfacing was placed some four years ago, and recently showed signs of weathering. Close inspection disclosed some ravelling; minor hair-cracks on the surface; and some loose material. This loose material, while of little importance during the days of conventional-type aircraft, had become a major source of expense after jets started operating here. Sand, small stones, and other loose material can cause considerable damage, when scooped into the jet engines.

Bitumuls Slurry is chuted into spreader-box as mix-truck travels at speeds up to 5 MPH.

A Dual Problem—The Navy was looking for answers to two problems: First, a method of revitalizing the runways and extending the life of the pavement surface. Second, a means of cutting down the repair bills involved when jet engines were damaged by loose material scooped up from the surface of the runways. *They found a single answer to both these problems in Bitumuls Slurry Seal!*

Bitumuls Slurry Seal composed of fine, sharp aggregate, Bitumuls Mixing Grade emulsified asphalt and water, was mixed in transit-mix trucks to a free-flowing, slurry consistency. It was applied by the squeegee action of a spreader-box to 350,000 sq. yards of runway and taxi-way. Contract for this work was awarded to George Reed, a contractor from Modesto, California.

To offset the high abrasive action of the aircraft tires on landing, a dilute (3 to 1) Bitumuls tack coat was placed ahead of the Slurry Seal to insure maximum adhesion.

Fast-Fast Application—It was "business-as-usual" at the Air Station while this work was in progress. In spite of the additional requirement of the tack coat, Bitumuls Slurry Sealing reduced interference with air traffic to a minimum. Planes at the Station were able to taxi over the fresh seal coat four hours after application. Jet aircraft landed on the new seal 24 hours after application.

The costs involved in providing this new life for the existing runway pavement was considerably less than that of a normal seal coat application.

"Meanwhile, at the Hangar..." In the repair shops, an extra "bonus" economy will be realized because Bitumuls Slurry Seal has eliminated loose material from the runways. *The cost of mechanical repairs occasioned by the induction of foreign material through the jet engines is expected to be sharply reduced.*

A Proved Procedure—Bitumuls® Slurry Seal has been proved on many installations—on highways, streets and airport runways—in terms of economy of initial application, and also in terms of durability. It can be applied in any quantity or volume for either construction or maintenance. Call our nearest office if you need additional information. It will be given gladly; and, of course, without obligation.

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Oakland 1, Calif.
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Cincinnati 38, Ohio
Tucson, Ariz.
Portland 8, Ore.

Recent Books

(Continued from page 22)

Aspects of River Pollution

This extensive study, by Louis Klein, is divided into fifteen chapters, each devoted to a particular aspect of the subject: nature and effect of pollution; causes; uses of river water; physical characteristics of rivers; sewage disposal and purification; disposal and treatment of trade wastes; etc. Each chapter is provided with a list of references to more detailed treatment of specific subjects, the number of references cited totaling over 1,300. (Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y., 1957, 621 pp., $14.50.)

Maintenance Engineering Handbook

This comprehensive handbook, containing contributions by more than eighty men, devotes about a third of the book to the management aspects of maintenance, such as organization and administration of maintenance forces, personnel, planning and scheduling, project control, and costs and budgets for maintenance operations. The remaining two thirds of the book covers the selection, installation, and upkeep of buildings; electrical, mechanical, service, and transportation equipment; maintenance stores and their control; lubricants and lubrication; instruments; sanitation; welding; and corrosion. (Edited by L. C. Morrow. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1957. $20.00.)

Plastic Design of Portal Frames

This volume, by Jacques Heyman, deals with the practical application of the plastic theory of design developed at Cambridge University in England. Intended for practicing engineers and advanced students, the book gives a concise exposition of basic principles and shows the application of the method to the design of the single-story, pitched-roof portal frame. Practical design examples are worked out. (Cambridge University Press, 32 East 57th Street, New York 22, N. Y., 1957. 104 pp., $2.00)

Practical Accounting and Cost Keeping for Contractors

Fifth Edition, 1957

The essentials of accurate cost keeping are described for contractors involved in both large and small operations, by Frank R. Walker. The book includes complete labor and material cost schedules, information on how costs should be reported from the job, how to gather and compile data from checking the workmen's time on distributing the labor hours, and on working costs into suitable units. Illustrations and descriptions of forms required—that is, Social Security records, expense sheets, progress reports, estimate sheets, etc.—are included. (Frank R. Walker, Publishers, 173 West Madison, Chicago 2, Ill. 255 pp., $5.00.)

Procedure Handbook of Arc Welding Design and Practice

Eleventh Edition, 1957

Provides useful information on all phases of arc welding for the machine designer, the structural engineer, the fabricator, the welder and all those interested in metal joining. The 8 sections cover: history, nomenclature and processes, weldability, mild steel procedures, manufacturing cost data, machine design, structural design, applications and reference data. The structural section has been completely rewritten and includes the latest data on welded design. The weldability section includes information on welding such new materials as zirconium and titanium. (Published by The Lincoln Electric Company, Cleveland 17, Ohio. $3.00.)

Protective Painting of Structural Steel

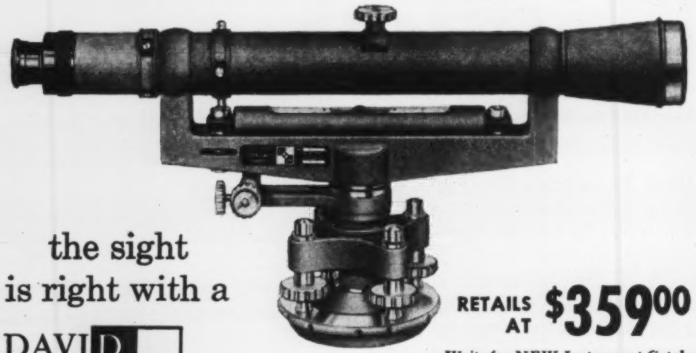
This is a concise and simple statement, by F. Fancutt and J. C. Hudson, of the best methods for protecting new or old steelwork against atmospheric corrosion by the use of paint alone or by paint used in conjunction with metal coatings. The recommendations are based on investigations carried out by the Protective Coatings (Corrosion) Sub-Committee of the British Iron and Steel Research Association. (The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. 1957, 102 pp., $4.50.)

Seminar on Wind Tunnel Techniques and Aerodynamics

The papers of this seminar, held in Stockholm, May 1954, cover many aspects of the subject including the design and use of sonic and supersonic wind tunnels, strain gage balances, electronic apparatus, flow around various types of wings, drag and air intakes. Swedish wind tunnels are described, and a final paper discusses the financial background and organization of aeronautical research and development in Sweden. (Royal Institute of Technology, Stockholm, Sweden, 1955. Price not given.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.



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Men Available

Engineer-Lawyer, M. ASCE; all-round good civil engineer; unspecialized and unsplintered. Desires location in South or West. C-230.

Civil Engineer, J. M. ASCE; B.C.E.; 24; 6 months take-off, estimating materials and cost, drafting and field supervision of prefabricated concrete forms. 21 months as draftsman and surveyor with Seabees, U. S. Navy. Location desired, West Coast. C-231.

Supervising Civil Engineer, J. M. ASCE; B.S.C.E.; 35; municipal, consulting and construction civil engineering. Varied—15 years'. Location desired, California. C-232-786.

Civil Engineer, Structural and Hydraulic; A.M. ASCE; B.S. in C.E.; licensed P.E.; with 10 years design experience, including 18 months as office engineer. Experienced in surveying, irrigation, hydrology, hydraulics, and structural design. Desires position in New York State or New England. C-234.

Manager-Coordinator, J.M. ASCE; B.C.E; 24; 2 years' management work as a naval officer. Location desired, San Francisco, Calif. C-233-784.

Positions Available

Structural Engineer. Must have professional engineer's license in the State of New York; some experience in structural design, building construction and maintenance of buildings and grounds. Will not handle any mechanical items. Salary to start, $9,360 a year, with opportunity to advance to $10,322 a year. Location, upstate New York. W-4846.

District Engineer, 30-45; either a civil or architectural engineering degree, preferably with a major in structural design; should have a professional license. Experience in design and construction in structural steel in a consulting engineer's office, with a structural steel fabricator, a contracting organization or in the teaching profession; some sales promotion experience; design and construction experience in reinforced concrete and other structural materials; also some trade association experience desired. Salary open; insurance and retirement plans offered. Some travel. Headquarters, Alabama. W-4930.

Construction Superintendent, 40-50, with experience in soil analysis, compaction, base course material and soil stabilization and a knowledge of soil engineering and asphalt road construction. Preferably some Spanish. Salary $10,800 a year plus per diem allowance. Location, Ecuador. F-4937.

Civil Engineers, Designers, experienced in various phases of highway and/or airfield designs and capable of directing small squad of engineers. Also recent graduates interested in gaining experience in these fields. Salaries open. Location, central Ohio. W-4953.

Project Engineer with at least ten years' cement mill construction, equipment installation and general operating experience. Salary, $15,000-$18,000 a year plus extras. Location, Far East. F-4965.

Assistant Professor, graduate civil engineer, to teach courses in highway construction. Should have 3 to 5 years' field and office experience in highway design, construction and surveying. Teaching experience highly desirable. May teach following subjects during the school year: Surveying, estimating, drafting, highway design and office practice. Salary $5,748-$7,470 a year, with 1 month's vacation; extra compensation for evening school instruction. Location, New York Metropolitan area. W-4989.

Chief Structural Engineer, graduate with creative ability and imagination, and a thorough knowledge and experience in design and fabrication of indeterminate steel structures; will work closely with top management and clients in development and design of offshore drilling rigs. Salary, to $18,000 a year. Location, Louisiana. W-5018.

Structural Engineers, Canal, graduate engineers. (*a*) Chief Engineer to supervise group of designers on canal design and construction. Salary, $14,000-$15,000 a year. (*b*) Assistant Chief Engineer on above. Salary to $14,000 a year. (*c*) Designers on canal design. Salary, to $12,000 a year. All positions minimum 18 to 24 months' contract, complete foreign and United States tax free, western style housing furnished free, except for utilities for a consultant. Location, Japan. Employer will pay the placement fee. C-6291.

Architectural Engineer, 35-50; degree in architectural engineering with a minimum of 10 years' experience in building design and construction including experience in all mechanical trades. Will check designs, specifications, and construction contracts for public buildings construction program. Salary: Commensurate with past earnings and experience; transportation expenses and quarters allowances will be paid. Climate sub-tropical; family may accompany employee with travel expenses paid. Duration 12-14 months with possibility of extension. Location, Far East. F-5037*a*.

Instructors for civil engineering department, bachelor's degree preferred so that specialization may fit instructor and departmental needs. Extra work for consultants permitted. Graduate courses may be taken. Salary, $4,050 for 9 months. Position available September 1, 1957. Location, South. W-5049.

Senior Structural Design Engineer to lay out the designs for structural steel work involving 16 buildings in Brazil. 6-9 months' in South America with return to New York after. Salary plus bonus and living expenses. Headquarters, New York, N. Y. F-5054.

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(Continued on page 116)

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(Continued from page 114)

$6000 a year plus bonus. (*c*) Construction Superintendent with at least 5 years' field engineering supervisory concrete construction experience. Salary $8,000-$10,000 a year. Headquarters, New York, N. Y. W-5038.

Chief Structural Engineer-Buildings, B.S.C.E.; 45-plus; registered professional engineer, to supervise structural designers and provide structural engineering to meet client design requirements within construction cost budget, meet time schedules and internal cost budgets. Experience on tall commercial buildings preferred. Salary, $12,000 a year. Location, southern California. S-2892.

Office Engineer, civil, mature, for an engineering and surveying practice. Must be able to organize work and trouble shoot difficulties in both field and office. Experience and ability are prime requisites. Location, western Pennsylvania. W-5055.

Teaching Personnel for Department of Civil Engineering. (*a*) Instructor, B.S. in C.E., to teach engineering drawing, descriptive geometry, plane surveying and mechanics. Salary dependent upon education and experience. (*b*) Assistant Professors, 2, M.S. degree preferred; subjects to be taught dependent upon interest and experience. Salary dependent upon interest and experience. Location, Midwest. W-5061.

Construction Manager with at least 10 years' estimating, project engineering and office management experience with building contractor. Salary $10,000 a year. Location, central New York State. W-5062.

Stress Analyst for heavy steel structures; will entail considerable work with off-shore drilling platforms. Must have broad background in general stress analysis. Must be sufficiently experienced to work with new, unconventional problems. Salary open. Location, Southwest. W-5089.

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United States Civil Service Commission. The Bureau of Public Roads has openings for 25 Highway and Bridge Engineers for positions in Central America. Beginning salaries are $6,115 and $7,035 per year. Highway and Bridge Engineers are also needed throughout the United States for duty with the Bureau of Public Roads and other Federal agencies. Salaries range from $4,480 to $7,570 per year. Applications should be mailed to the Board of U. S. Civil Service Examiners, Bureau of Public Roads, Dept. of Commerce, Washington 25, D. C.

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Non-ASCE Meetings

American Public Works Association. Public Works Congress and Equipment Show at Grand Exhibition Hall, Philadelphia, Pa., September 22-25. Information from American Public Works Association, 1313 East 60th Street, Chicago 37, Ill.

American Society of Mechanical Engineers. First National Conference on Heat Transfer at Pennsylvania State University, University Park, Pa., August 12-15. Information from L. S. Dennegar, ASME, 29 West 39th Street, New York 18, N. Y.

Building Exhibition. Biennial exhibition at Olympia, London, November 13-27. Information from H. B. G. Montgomery, The Building Exhibition, 32 Millbank, London, SWI, England.

Pan-American Highway Conference. Seventh Pan-American Highway Congress in Panama City, Panama, August 1-10. Information from International Road Federation, 1023 Washington Building, Washington 5, D. C.

University of California. World Conference on Prestressed Concrete at the Fairmont Hotel, San Francisco, Calif., July 29-August 2. Information from the Department of Conferences and Special Activities, University Extension, University of California, Berkeley 4, Calif.

Applications for Admission to ASCE—April 27-June 1

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Harvey Kellogg Breckenridge, San Francisco, Calif.
Desloge Brown, Carlisle Barracks, Pa.
Frank Charles Ciochetto, Omaha, Nebr.
Francis Edward David, Jr., Alexandria, La.
Raymond S. DeMott, McLean, Va.
Augusto De Yta Navarro, Mexico, D.F., Mexico.
Domingo Diaz-Ambrona, Madrid, Spain.
Carlos Ernesto Droescher-Kendziora, Norman, Okla.
Harold Sheeler Floyd, New York, N. Y.
Edmund Arthur Foss, Elmhurst, Ill.
Michael Zachary Glasunow, New York, N. Y.
Herman Charles Holman, Stockton, Calif.
Carolus Marinus Johannes Willem Kohler, New York, N. Y.
John Bolling Lockett, Portland, Oreg.
Carlos Durand Manzanal, Santurce, P. R.
Edward Bernard Meyer, New York, N. Y.
Austin Barlow Milhollin, Boise, Idaho.
Daniel John Miller Jr., Buffalo, N.Y.

(Continued on page 118)

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Applications to ASCE

(Continued from page 117)

William Chester Morris, Mobile, Ala.
Thomas Lu Nieh, Philadelphia, Pa.
Nathan November, New York, N. Y.
Francis Leroy Ost, Allentown, Pa.
Arthur Virgil Potter, Los Angeles, Calif.
Morris Sidney Pynoos, Norwalk, Conn.
Mohanlal Purushottamdas Rathod, Bombay, India.
William Henry Tuller, Boise, Idaho.
Truex N. Upchurch, Chicago, Ill.
Arnold Felix Wahlrab, New York, N. Y.
Edward Louis Weeks, Highland Park, Ill.

Applying for Associate Member

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Pierre Francois Bertrand Bourgerol, Paris, France.
Guy Warren Buford, Roanoke, Va.
Dominic Romeo Cassella, New Haven, Conn.
Frank John Cava, Philadelphia, Pa.
Donald Davis Cherry, Houston, Tex.
Paul Edward Clowers, City of Oklahoma, Okla.
Jerry Cohen, Blytheville, Ark.
Gurney Hendrickson Dayett, Jr., Baltimore, Md.
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John Arendt Jensen, Redding, Calif.
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William Claude Leet, Louisville, Ky.
William Elmo Loftis, Oklahoma City, Okla.
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Abdul Rasul Mohamed Memon, Little Rock, Ark.
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James Byron Perry, Jr., Knoxville, Tenn.
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George William Reschke, Detroit, Mich.
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Elroy Francis Spitzer, New York, N. Y.
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Raymond Joseph Suarez, Knoxville, Tenn.
Denis Alino Sun, Ypsilanti, Mich.
David Hugh Trollope, Victoria, Australia.
Conrad Alberto Otto Tromm, Cooksville, Ont., Canada.
Dafalla Abdulla Turabi, Evanston, Ill.
Charle Laurice Vicker, Jr., Long Beach, Calif.
William Taylor Waterhouse, Denver, Colo.
Glennfranklin Welch, Los Angeles, Calif.
Eugene Marvin West, Lexington, Ky.
Charles Wesley Wood, Syosset, N. Y.
James See Sum Young, Honolulu, Hawaii.

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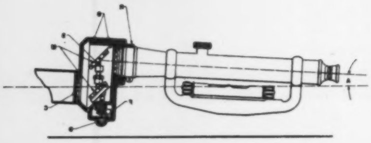
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Self Leveling Attachment

A SIMPLE, TIME-SAVING device that when attached to a surveying instrument, automatically provides and maintains a level or horizontal line of sight, has just been introduced to engineers and contractors. The new device affords the accuracy of a second order instrument.

The small and compact instrument can be attached, by an adapter, to the objective end of a telescope of any make level or transit. When in place, it is not necessary to carefully level the instrument before each sight is made. The instrument may be "out of level" to the extent that the bubble in the level vial is two divisions off center; yet, when using the attachment, the line of sight will remain horizontal.



The device consists of two optically flat mirrors, one of which is supported by a hydraulically dampened and frictionless spring bearing, the other permanently attached to an adjustable mount. When attached to the instrument by the adapter, the moving mirror acts by a gravity and spring combination to provide a correction to the line of sight, in an amount just sufficient to assure that it remains horizontal. The attachment comes complete with adapter in a leather case.

Operation of the attachment may be noted by referring to Fig. 1. The line of sight strikes the mirrors (M) and is reflected through the telescope. The lower mirror is supported by a very fine steel spring (S). This spring has been sized so that its strength will only allow the lower mirror to travel through half of the angle that the telescope and the body of the leveling device have been tipped. Since light reflects at the same angle that it strikes the mirror, this half angle is multiplied by two; therefore, the line of sight remains horizontal, regardless of the angle of the telescope.

The working parts of the attachment are protected by two cover glasses (C), eliminating dust and moisture.

To retard the pendulum action of the lower mirror, a heavy bodied silicone fluid (F) is used. A dampening blade (D) moves in this fluid to eliminate swinging.

The attachment may be installed on any telescope within the range of the adapter (R). This adapter may be supplied blank and fit to any telescope or may be purchased ready to attach to the David White Model No. 8114 or No. 8300. The process of adapting it to any telescope is simple in that the adjusting screws (B) are adjusted so that the viewer sees a point 1⅛" below a point seen with a properly adjusted level.

"The self-leveling attachment can give results satisfactory for work for which the builder and architect line of instruments are normally used. Its performance is satisfactory for ordinary leveling," report Professors E. C. Wagner and H. A. Kallsen, University of Wisconsin, after testing its performance. **The David White Instrument Company, CE 7-120, 2051 N. 19th St., Milwaukee 5, Wis.**

Stake Puller

PULLING STAKES NEED NO longer be a costly time consuming operation according to the manufacturer of the Universal Stake Puller.

Designed to pull stakes quickly and easily with no damage to the stake it is adaptable to both wood and steel stakes. The adjustable plate on the jaw will accommodate every type of steel stake, angle, tee, channel, flat or round. It will pull steel pipe or rods ¼-in. to 2½-in. dia and can also be used to pull rods from concrete walls. **Universal Form Clamp Co., CE 7-120, 1238 N. Kostner Avenue, Chicago 51, Ill.**

Aluminum Sheeting

A NEW STEAM-CARRYING PIPELINE system that is protected from rain, snow, dirt and ice by a gleaming, corrosion-resistant aluminum jacket, now is in operation at Esso Standard Oil Company's Bayway refinery.

The aluminum application, one of the largest of its type, employs 80,000-lb of alloy 3003 sheet produced by Aluminum Company of America. It shields 5½-miles of large diameter insulated steel pipe from damaging weather and a corrosive industrial-marine atmosphere.

To conserve heat and maintain steam efficiency, each new pipeline is wrapped in mineral wool insulation manufactured by Baldwin-Hill Co., Trenton, N. J., and jacketed with Alcoa aluminum.

In performing the big insulating job, the Trybee Co., Inc., Garfield, N. J., first wrapped the lines with the blanket-type insulation, then added a layer of 15-lb roofing felt. Aluminum sheet in alloy 3003 was cut to size, shaped and punched prior to reaching the job site. When installed, the easily handled sections were drawn tightly around the felt-covered insulation, and secured with self-tapping screws.

At elbows and fittings in the pipelines, mineral wool insulating-finishing cement and asphaltic mastic weatherproofing compound were used in place of aluminum sheet and then coated with aluminum paint. **Aluminum Company of America, CE 7-120, 1501 Alcoa Bldg., Pittsburgh 19, Pa.**

New Drawn Scrapers

A NEW, ADJUSTABLE CUTTING edge for the bowl is among the many outstanding features offered by two new tractor drawn scrapers.

The 4S-85, which carries 16-cu yds struck, is matched in weight and capacity for use with the Inter'l 200-hp TD-24 crawler tractor, or a unit with similar horsepower; the 4S-55, hauling 10-cu yds struck, is constructed to team with a machine with the power of the 105-hp TD-18 crawler tractor.

Sideboards boost the material-handling capacity of these new units to 22-cu yds heaped and 19-cu yds struck for the 4S-85, and 15-cu yds heaped and 12-cu yds struck for the 4S-55.

4S-85

The new type cutting edge on the scraper blades consist of three interchangeable, reversible segments. These permit the operator to shift to one of three cutting depths to match soil conditions and boost loading efficiency.

The ground-hugging feature, low draft arm connections and outside-mounted apron arms on the new units insure fast, positive loading action, according to the manufacturer. **International Harvester Co., CE 7-120, 180 North Michigan Avenue, Chicago 1, Ill.**

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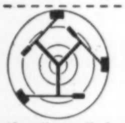

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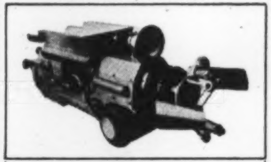

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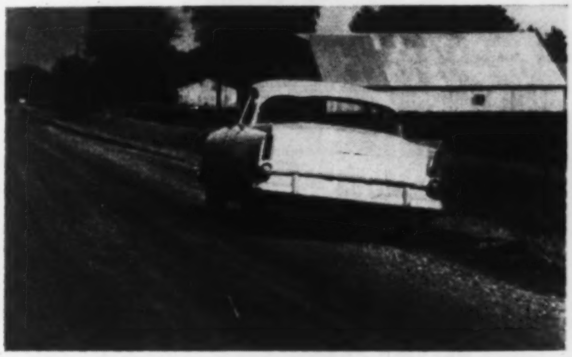

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EQUIPMENT, MATERIALS and METHODS

(continued)

Cement Dust Recovery System

A MODERNIZATION AND EXPANSION program started almost three years ago at the Nazareth, Pa., plant of Lone Star Cement Company is now nearing completion. When finished, the program will include replacement of three existing kilns with two larger ones, lengthening and modernizing of two additional kilns, and complete replacement of the cement dust recovery system.

The dust treatment and collection system was designed and will be installed under the supervision of Research-Cottrell, Inc. It will consist of a gas conditioning system to cool the 1400-deg F kiln exit gas, by water spray and atmospheric air dilution, to 600-deg F, a temperature at which it can be handled by the structural steel components. The water treatment also conditions the dust particles and decreases their resistivity, allowing increased collection efficiency in the electrostatic precipitator. A Cyclotrell mechanical collector that follows, to scalp the low alkali coarse particles and return them to the kiln charge, is made an integral part of the shell of the final stage of collection in the electrostatic precipitator. The electrostatic precipitator discharge wire and collecting plates are both equipped with electrically powered rappers to maintain optimum efficiency.

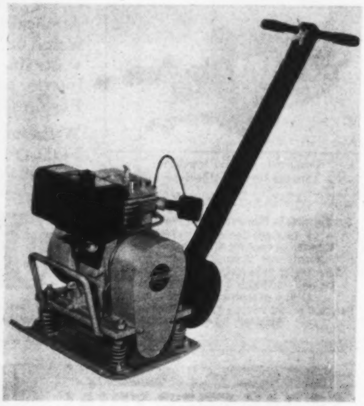
Precipitators and water-spray conditioning towers will be located on a concrete structure about 50-ft above grade. This structure was designed by the engineering department of Lone Star Cement Co. **Research-Cottrell, Inc., CE 7-122, Bound Brook, New Jersey.**

Vibratory Compactor

CALLED THE POWR-PACTOR, the new compactor provides variable vibrating frequencies from 2400 to 7000-vpm, with compacting forces ranging up to 4000-lbs. This variable frequency and force permits selection of the exact degree of compaction necessary to produce uniform Proctor densities on any job, the manufacturer states. Compacting plate, of ⅜-in. alloy steel, affords 12 x 18-in. of effective compacting area. The unit weighs 230-lbs.

Power is provided by an air-cooled Wisconsin ACN engine with standard carburetor. The engine is mounted on a vibration-free plate. Resilient damping springs are said to isolate vibration from engine and operator's handle. This assures maximum engine life without need for special components and minimizes operator fatigue, it is claimed. A V-belt driven vibrator eccentric rotates on 4 high speed ball bearings within a sealed housing, attached to the compacting plate.

According to the manufacturer, the Powr-Pactor is designed for operating ease and efficiency. The engine throttle is located on the operator's handle and a centrifugal clutch allows the engine to idle without vibrating the compactor. The clutch also permits engine starting and warm-up with the vibrator automatically disengaged. Dolly wheels facilitate movement on the job and a lifting bail is provided for loading. **Maginniss Power Tool Company, CE 7-122, 154 Distl Avenue, Mansfield, Ohio.**



Powr-Pactor

Throttle Control

A REVOLUTIONARY NEW THROTTLE control for users of power take-off equipment has been developed. The Stratton Hydro-Throttle Control is very inexpensive and easily installed on any engine and gives the exact throttling speed necessary for proper load lifting. It eliminates setting engines ahead, saves clutch wear and fuel consumption. It is adjustable in seconds to work with any hydraulic pressure system giving completely automatic remote control.

Just 5-in. long and weighing 1½-lb the patented control needs no lubrication or spring changes for continuous operation on any hydraulic equipment deriving its power from a P.T.O. unit. It is simple and foolproof in operation. Pressure from the P.T.O. pump or equivalent automatically actuates the piston. Thus, as the pressure increases to lift a load, the piston is forced into action to speed the engine to the proper rpm. As the load is stopped or the pressure is reduced due to varying conditions, the throttle instantly and automatically returns the engine to idling speed. **The Stratton Equipment Co., CE 7-122, 2030 East 105th St., Cleveland 6, Ohio.**

TIDE GATES

FIVE 96" x 96" TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

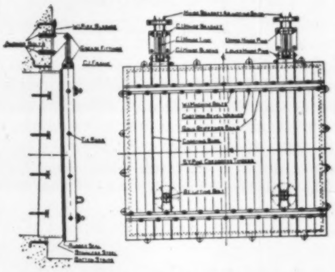


FIG. 9320 SHOWING TYPICAL CONSTRUCTION

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EQUIPMENT MATERIALS and METHODS

(continued)

Truck Mixer

The addition of a model 550 Transcrete to their line of truck mixers has been announced.

The new Model 550 has a drum volume of 243-cu ft; carries a mixer rating of 5½-yd, and as an agitator is rated to carry 6 to 6½-yd of concrete.

Available with optional Ford or Chrysler separate engine power it is also offered in the popular CMC TED (truck engine drive). The 550 has all of the proved transcrete features, including floating drive, swing-out hopper and has a favorable center of gravity for load distribution and stability. All regular accessories are available.

Model 550 Transcrete

The addition of the new mixer to their line now gives a choice of 5 popular sizes and permits the selection of a machine that will mount advantageously on all standard trucks or carriers to give maximum payloads under the various weight restrictions in different areas. **Construction Machinery Co., CE 7-123, Waterloo, Iowa.**

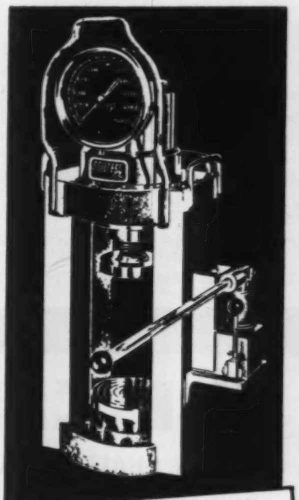
Hydraulic Track Adjusters

Hydraulic track adjusters are being installed as standard equipment on both the 5-roller and 7-roller track frame arrangements of the Caterpillar D7 Tractor, for use with the MD7 Pipelayer, according to a recent announcement.

The adjusters used on this model pipelayer are essentially the same as those currently being offered as standard equipment on the Caterpillar D7, D8 and D9 Tractors.

Hydraulic adjusters on the D7 arrangement for the MD7 Pipelayer allow track tension to be quickly and easily maintained, without the use of wrenches. The only tool necessary for operation of the adjusters is an ordinary hand grease gun, with track tension being set by hydraulic pressure. **Caterpillar Tractor Co., CE 7-123, Peoria, Ill.**

JOB-SITE TESTING SAVES MONEY



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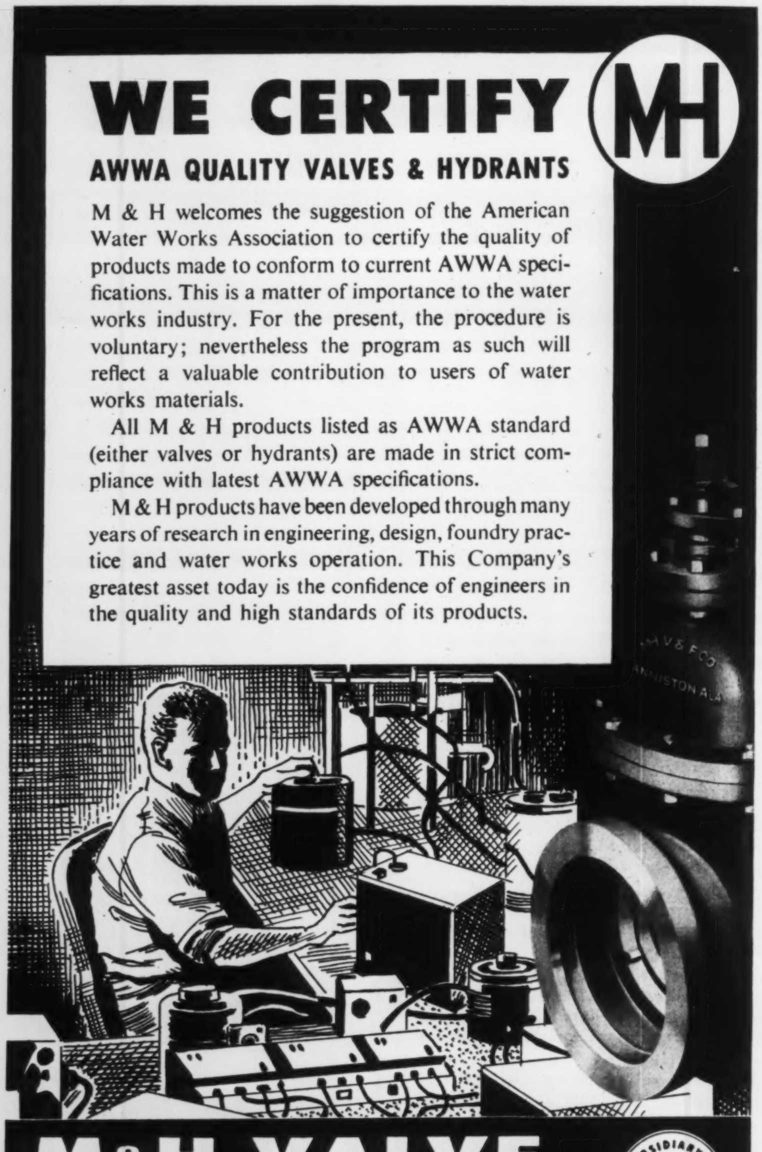
Dimetric Protractor

A NEW AND INTERESTING ITEM, the Dimetric Protractor, has been added to the line of "Instrumaster" Drawing Instruments for Axonometric Drawing. This handy instrument conforms to the Dimetric Ellipse Stencils No. 102, 202-A/B, all based on a scale ration of 1:1:.5.

The new protractor is made of clear vinyl stock and contains complete graduations of 180-deg each, for the two different scale sections of the Dimetric System, and the numerals covering 90-deg from a zero mark both in clockwise and counterclockwise direction. Since the material of the protractor is transparent and may be used in regular and in reversed position, a second set of numerals is provided in reversed figures, so that the numerals can be read directly in regular as well as in reversed position of the protractor.

The edges are cut so that by placing any edge against the T-square or drafting machine edge, the protractor is automatically oriented in correct position. A dimetric half-square in every half of the protractor helps placing the protractor on the drawing in proper relation thereto.

A pair of half-ellipses of 2-in. size can be used advantageously for determining the dimetric length of lines extending in angular directions not parallel with the main axes of the Dimetric System. **John R. Cassell Co., Inc., CE 7-124, 110 W. 42nd St., New York 36, N. Y.**



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M & H welcomes the suggestion of the American Water Works Association to certify the quality of products made to conform to current AWWA specifications. This is a matter of importance to the water works industry. For the present, the procedure is voluntary; nevertheless the program as such will reflect a valuable contribution to users of water works materials.

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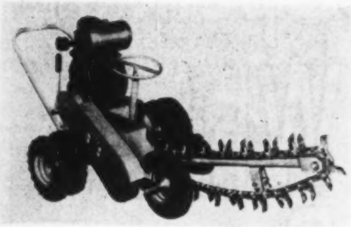
Cost-Cutting Insulation Technique

BY INSULATING A BOILER smoke stack prior to setting on its permanent foundation, engineers at the company's Cincinnati, Ohio refinery, eliminated the need for scaffolding and cut costs on the job to a minimum.

Shop fabricated stack was set on blocks and insulated with two one-inch magnesia blocks held in place with stainless steel bands placed one-inch apart. Surface was covered with one-inch #19 galvanized poultry wire which served as a lath and reinforcement for application of Laykold Weathercoat, cold-applied asphaltic protective material. Material was troweled on in two thin layers. After curing, stack was lifted at top by a crane and lifting lugs, and set on foundation. **American Bitumuls & Asphalt Company, CE 7-124, 200 Bush St., San Francisco, Calif.**



Model M Ditch-Witch

Trencher

THE NEW MODEL M DITCH-WITCH trencher is completely mobile with three forward digging speeds and reverse plus road speeds up to 5-mph. In usual digging conditions the Model M will trench at speeds of 1½ to 6-fpm. It is also equipped with a trailer hitch for towing at speeds up to 25-mph.

Trenching widths and depths available on this machine are: 3-in. wide up to 48-in. deep, 4-in. wide up to 36-in. deep and 6-in. wide up to 30-in. deep. The digging chains are quickly interchangeable on the job.

When digging, all spoils are deposited on one side of the trench, leaving the other side clear for access to the trench. The Model M may also be used for under-cutting sidewalks and other obstructions by trenching in reverse gear.

Powered by an 8-hp air cooled engine and equipped throughout with sealed ball bearings, the Model M weighs 500-lb. **Adam Company, CE 7-124 and 125, P. O. Box 628, Perry Okla.**

Impact Wrench

A MANUALLY OPERATED IMPACT WRENCH recently developed, is the first hand-powered tool that incorporates the impact principle. The Swench has the ability of delivering torque values up to 20 times that applied to the handle by the operator, allowing a single operator to manually tighten to practical tensions bolts up to 1¾-in. in dia. As the impact force can be controlled through a simple spring setting, any desired bolt tension can be produced by the operator through control of the impact force and the number of impacts applied to the fastening.

The wrench has two drive extensions, one for loosening and one for tightening fastenings, and is operated like an ordinary ratchet wrench, using standard sockets to engage the nut or head of the fastenings. As the handle is pulled, a spring and rotar mechanism delivers rotary hammer blows or impacts automatically through the socket to the fastening, at torque values up to 20 times that applied to the tool handle by the operator. One impact or hammer blow is delivered for every 30-deg of movement of the handle. Impacts may be delivered in succession by continuous movement of the handle in one direction, or by reciprocating the handle like a ratchet wrench, the operator can apply impacts singly or in short bursts. Control of the force delivered by each impact is achieved by the settings of an indicator on the head of the spring arbor. **Swenson Engineering Co., CE 7-125, P.O. Box 43, Branford, Conn.**

Independent Units

Vibratory Compactor

THIS COMPACTOR, RECENTLY MADE available, is of the vibratory pan type having 6 independent compactor units in the workhead which may be detached and operated individually grouped or re-grouped to fit job requirements.

In this respect, according to Mr. A. W. Davis, Vice President in charge of construction equipment, it follows the general design of the previous Jackson Compactor which was widely and successfully used on most of the large national paving projects.

Power, however, has been stepped up to the point that each of the 6 compacting units now delivers up to 4200 3-ton blows per min—an increase of approximately 2000-lbs per blow over the previous model. Specified density he says is very rapidly achieved and production proportionately increased. Among other improvements are a single industrial engine of ample power (instead of two) operating both the generators and the transmission.

Two generators produce single phase and 3-phase, 110-130-v, 60 cycle a-c and it is pointed out that with the compactors removed, the machine constitutes a very efficient mobile power plant. Speed of travel is said to be 10-fpm to 10-mph. **Jackson Vibrators, Inc., CE 7-125, Ludington, Mich.**

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EQUIPMENT MATERIALS and METHODS

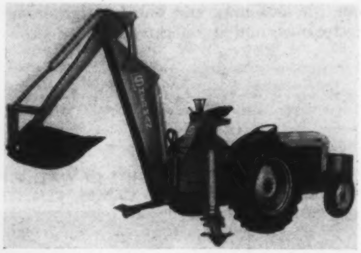
(continued)

Power Digger

A COMPLETELY NEW POWER DIGGER for mounting on Ford Tractors has been introduced. The unit, which features fast digging and long life, joins the company's successful line of Sherman Major Power Diggers for Fordson Major Tractors, Fork Lifts, Front-End Loaders, power steering units and special transmissions.

Several outstanding features develop the speed of the new unit, according to Sherman engineers.

One is exceptional power as illustrated by a breakaway capacity of 9000-lbs. Contributing to this power and speed is a new hydraulic system. It is extremely compact in design to permit short hydraulic lines which minimize friction power loss.



Sherman "F"

Another contributing factor is the pump drive from the tractor PTO at the rear, which through an exclusive Sherman Planetary Step-up Transmission develops greater digging speed than conventional systems. Hydraulic system pressure of 2000-psi is outstanding and also speeds operation work.

A wide work radius and a long reach also speed operations. The Sherman "F" can excavate a trench 15-ft, 8-in. long from just one tractor position. The arc of swing is 188-deg, the reach below grade is 12-ft, and the loading height, 9-ft, 2-in. **Sherman Products, Inc., CE 7-126, Royal Oak, Michigan.**

New Construction Product

A NEW TYPE OF EXPANSION joint material and caulking compound which elongates 325% through the normal temperature range of 70-80-deg F has been introduced.

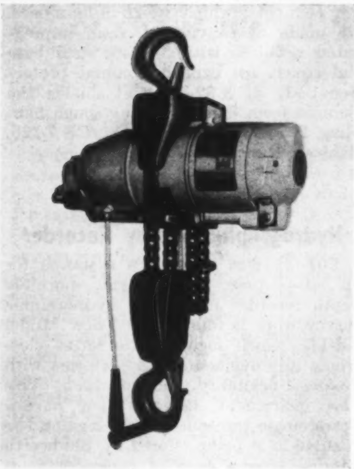
Known as Hornflex Rubber Expansion Joint and Caulking Compound, this new material maintains a tight seal of joints by squeezing and stretching with any movement. A two-component product mixed prior to use and applied either by caulking gun or knife, it is especially effective in curtain wall construction and on surfaces where adhesion is difficult.

Among the applications of the compound are the filling and sealing of surface joints in bridges, buildings, highways and swimming pools, and between metal panels of stainless or enameled steel, glass in needlepoint glazing and building materials of dissimilar surface density and texture. **A. C. Horn Co., Inc., subsidiary of Sun Chemical Corp., CE 7-126 and 127, Long Island City, N. Y.**

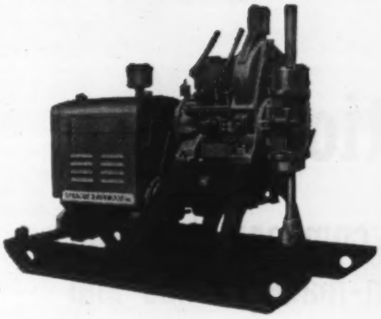
Air-Powered Hoist

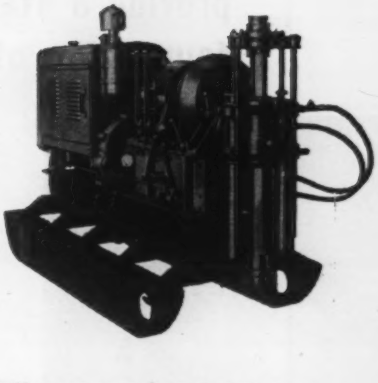
A NEW 4000-LB CAPACITY HOIST has been added to the line of air-powered hoists made by the Keller Tool Division.

Fitted with either roller or link chain, the lifting and lowering speed varies from a creep to 10-fpm at full load and 90-psig air line pressure. Length of lift is 8-ft and the hoist operates with either a one-hand control bar or remote pendent control. The axial-piston compressed air motor assures positive starts and stops, prevents motor burnouts during stalls. A centrifugally governed, fully mechanical brake prevents slippage. When the air supply fails or maximum lowering speed is exceeded, the brake design permits the operator to retain control of the hoist while lowering the load.



The hoist weighs 100-lbs, is equipped with swivel-mounted safety suspension and load hooks. Hook-to-hook dimension is 23½-in. **Gardner-Denver Co., Keller Tool Division, CE 7-127, Grand Haven, Mich.**





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Man-made Islands Connect 6860 foot Tunnel with Two Bridges for Vehicular Traffic at Hampton Roads Crossings, Va. For: Commonwealth of Virginia, Department of Highways. Contractor: Merritt-Chapman & Scott Corp. Consulting Engineers: Parsons, Brinckerhoff, Hall & Macdonald.

Vibroflotation®

was used to compact the sand on these man-made islands and provide a stable base for the foundation of tunnel portals.

North Island is man-made and covers 4½ acres. Its approach strip and entrance has foundation compacted by VIBROFLOTATION. The same is true of South Island.

The tunnel portals of North and South Islands are supported in a compacted mass of sand to prevent possible future foundation settlements.

A bed, 20 ft. deep and 50 ft. wide, was compacted to support the ramps from bridge to tunnel. Maximum depth of vibroflot penetration was 62 ft. Minimum depth was 10 ft.

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V-13

EQUIPMENT MATERIALS and METHODS

(continued)

Heavy Duty Air Filter

A NEW HEAVY DUTY AIR FILTER which permits uninterrupted operation of expensive construction equipment in dust laden atmospheres and at the same time vastly extends the useful life of such equipment has been developed.

The new filter, for use on tractors, scrapers, rock drillers, sand blasters, cranes, crushers and pneumatic drill equipment, has proved 99.5% efficient in protecting compressors and engines from wear, thus cutting costly downtime significantly.

Making use of a pair of heavy duty elements in series, each containing 4800-sq in. of filtering area, the new Purolator air filter's positive action keeps abrasive particles of all sizes from delicate wear parts. The first stage element has resulted in uninterrupted operations of up to 400-hr, with the only element servicing necessary being a daily air-washing and rapping for cleaning purposes.

Housings of the new filter unit are constructed of heavy gauge steel while the elements, which weigh 9-lb apiece, are made of convoluted, resin impregnated cellulose with 3/32-in. steel base and cover. An expanded metal protective body of 3/32-in. steel shields the element from damage during rough handling. **Purolator Products, Inc., CE 7-128, Rahway, New Jersey.**

Hydrographic Survey Recorder

THE ANSWER TO TODAY'S DEMANDS for an all-purpose, light-weight, portable depth recorder for use in hydrographic survey work is found in the new Model ES-130, which includes the latest electronic improvements and performs with greatest flexibility and precision. This new instrument, using a new narrow beam single transducer and weighing less than 40-lb is being offered by Bludworth Marine after a year of extensive field-testing.

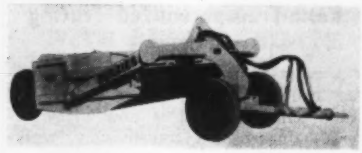
Model ES-130's single barium titanate transducer weighs less than 4-lb and is suitably faired to prevent introduction of harmful turbulence when operated at vessel speeds of eight knots.

Operating on a fixed acoustic frequency within the band 200 to 220 kc, the recorder has a depth range to 245-ft with 4 scale ranges of 65-ft each. Recordings are displayed on paper with over 7-in. of useful range. The recorder paper is 75-ft long, wound on aluminum spools. The system will plainly record a depth within 2-ft of the transducer face. **Bludworth-Marine, Division of Kearfott Co., CE 7-128, 1500 Main Avenue, Clifton, N. J.**

New 5-Cu Yd Scraper

A NEW SCRAPER, THE Gurries GS-2, built to match the power of Cat D2 and D4 Tractors, has a 3.60-cu yd struck capacity and a 5.0-cu yd heaped capacity.

A hydraulic cylinder raises and lowers the bowl. A shallow angle blade cuts draft and permits a heaped load with minimum power. Load is quickly and completely dumped by hydraulic power which raises apron and dumps load. Load can be spread in thin controlled layers or dumped in one spot.



GS-2

The GS-2 takes a 7-ft cut, and rear wheels track inside cut. It fills a place in the scraper line as low-cost companion equipment for the smaller Caterpillar track-type tractors. **Gurries Manufacturing Co., CE 7-129, 1720 South First St., San Jose, Calif.**

Cathodic Protection

A COMPREHENSIVE SYSTEM OF cathodic protection is being installed for the Falcon Dam Project on the Rio Grande River near Roma, Texas. Scheduled for completion by the end of June, this system employs a combination of impressed current and graphite anodes, together with large quantities of magnesium (sacrificial) anodes.

The structures protected against corrosion include spillway and intake gates, penstocks, the interior of a 100,000-gal elevated water tank, and special water treating equipment.

Completed at a reported cost of approximately $30,000, the system is designed to eliminate corrosion damage to equipment and structures valued at many times that figure.

First widely accepted as a method for mitigating costly corrosion of petroleum and gas pipe lines, refinery and chemical plant equipment and oil well casing, cathodic protection is the subject of increasing interest in the broad construction field wherever buried or submerged metal is subjected to the galvanic action of soil or water. Essentially, it consists of various means of reversing the normal flow of galvanic current—the cause of underground or underwater corrosion—so that it flows toward, rather than away from, the structure being protected. **Corrosion Rectifying Co., Inc., CE 7-129, Houston, Texas.**

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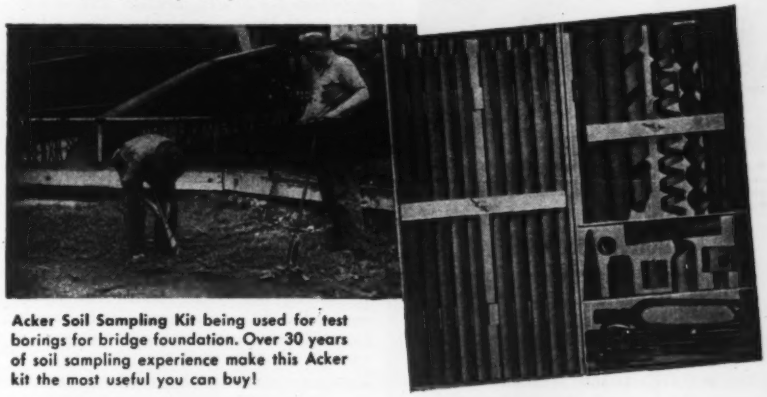

Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

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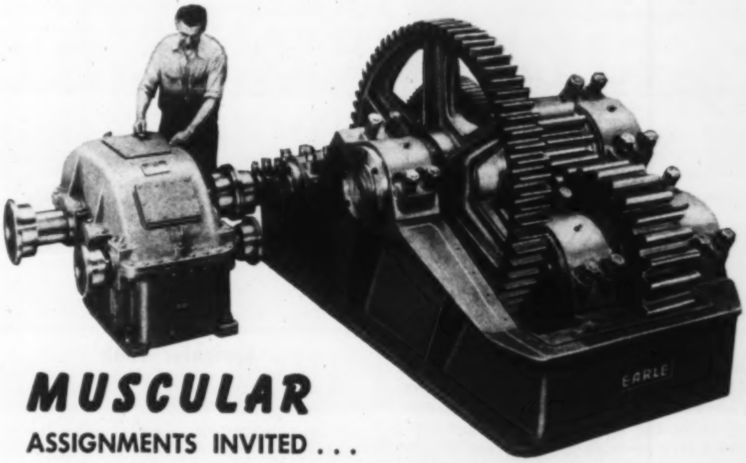

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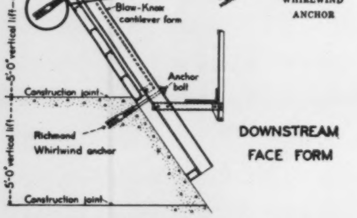
Massive Pours

Merritt-Chapman & Scott and The Savin Construction Corp., contractors, used 55,800 Richmond Whirlwind Anchors *without slip or spall* in this vast dam construction at American River, Folsom, California.

Economies with Richmond Whirlwind Anchor

In dam construction like the above, considerable speed and economy are to be gained by pouring successive monoliths in 5 ft. lifts into steel cantilevered forms. Success of this money-saving method depends, however, on one-point form anchorage that will positively withstand massive overhead pours and loads imposed from all directions. Richmond's *Whirlwind* anchor was designed especially to prevent slip for rugged work of this kind.



These Richmond anchors are mounted on the form before each monolith is started. Installation is easy. The *Whirlwind* is made with double coils, one coil takes the form bolt, the other supplies added anchorage to prevent slip in concrete during its low early strength period. There is no spalling. Richmond's development of these special anchors has been in large part responsible for the constantly increasing popularity of this fast, more economical, anchorage and pouring method.

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For more information, or a copy of the Richmond Handbook of tying devices, anchorages and accessories for concrete construction, write: RICHMOND SCREW ANCHOR COMPANY, INC., 816 Liberty Ave., Brooklyn 8, N. Y. or 315 S. 4th St., St. Joseph, Mo.

EQUIPMENT, MATERIALS and METHODS

(continued)

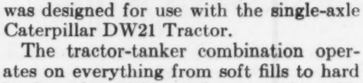
Financing Treatment Plants

A COMMUNITY, WITH A PRESSING need for a sewage or water treatment system, but unable to finance the improvement either because its bonding limit has been reached or because of voter apathy, should investigate a solution offered by Municipal Service Company, contracting engineers for water, sewage and industrial waste treatment plants.

This 27 year old Kansas City, Mo., corporation can offer a package plan to finance, construct and operate an entire system. Under the plan a non-profit corporation is formed which functions as a utility. The corporation, through the Municipal Service Co., would build the plant, lease it to the community at cost, which will be liquidated by annual payments based on sewer service charges.

As soon as the debt is retired, over a period comparable to the depreciation period of the plant, ownership would revert to the community. Plans would be made and construction supervised by the city's consultant, and construction contracts would be awarded by competitive bidding.

Prompt financing can shorten the time needed to complete construction. A similar package plan is available to industries needing waste treatment facilities. Inquiries for a printed brochure describing the package plan should be addressed to **Municipal Service Company, CE 7-130, 4625 Roanoke Parkway, Kansas City, Mo.**



STT-60

Sprinkler Tank

A NEW, HIGH-CAPACITY, 6000-gal, semitrailer sprinkler tank is now available to the construction industry. The trailer was designed for use with the single-axle Caterpillar DW21 Tractor.

The tractor-tanker combination operates on everything from soft fills to hard haul roads quickly and accurately, with a minimum of time and effort. Large 29.5 x 29 tires afford adequate flotation on the softest materials.

Designated the STT-60 by Southwest, the trailer is 10-ft wide and 11-ft, 10-in. high. The tank section is 18-ft long, 76-in. deep and 108-in. wide. Wheel base of the trailer is 27-ft, 3-in. and length of both units is 45-ft.

Front and rear spray bars are equipped with adjustable nozzles with a spray swath up to 55-ft. The 1500 gpm spraying pump is a 6-in., self-priming, centrifugal type powered by a six-cylinder gasoline engine. Simple, finger-tip, air-actuated in-the-seat controls are regulated by the tractor operators. Gravity type bar is included as standard equipment. **Construction Machinery Division, Southwest Welding & Mfg. Co., CE 7-130, 3201 West Mission Road, Alhambra, Calif.**

Resin-Transparentized Tracing Paper

A NEW RESIN-TRANSPARENTIZED, 100% rag content tracing paper under the trade name Visi-Vel is now being offered. Unsurpassed translucency, workability, permanence and uniformity are outstanding features of this item.

This new paper offers exceptional translucency and, by actual test, can boost print production as much as 25% over other transparentized papers. In visual characteristics, Visi-Vel provides a perfect balance of visual opacity and transparency to assure easy, comfortable visibility of drawing surface and line when making original drawings and excellent visibility of underlying image when making tracings.

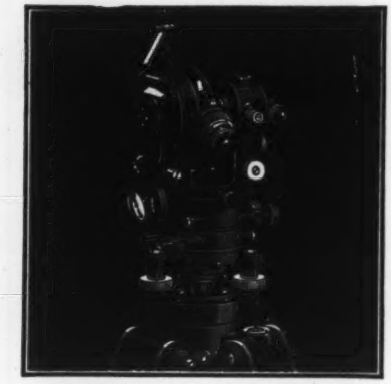
Visi-Vel accepts pencil hardness up to 9H without tearing or puncturing, and areas can be cleanly erased and re-erased repeatedly without damaging its drawing qualities. This paper withstands heavy handling in drawing, reproduction, and filing because of its exceptional inherent strength. **Charles Bruning Co., Inc., CE 7-130, 4700 Montrose Ave., Chicago 41, Ill.**

Overhead Sand Units

THE JEFFREY OVERHEAD SAND UNITS have been designed to fill the need of low-cost installations and to increase production by providing overhead sand molding stations.

Conditioned sand from the sand preparation plant is delivered by front-end loader and dumped into the feeder hopper from which it is discharged by means of a mechanical vibrating conveyor with stainless steel pan to the vertical belt-type bucket elevator equipped with malleable iron buckets. From the head of the bucket elevator, sand is discharged through a chute onto a flat belt conveyor equipped with plows for diverting sand into each molder's hopper.

To fill the molds with sand from the overhead hoppers, the operators merely pull the levers of the clam shell valves. No shoveling is necessary to fill the molds. This type of installation eliminates piling of sand on the floor and thus frees valuable floor space for more productive work. **The Jeffrey Mfg. Co., CE 7-130, Columbus 16, Ohio.**



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Films Available

"We're Blasting Near You"—An animated color film helps users of explosives tell their neighbors about the control, safety and confinement possible with modern techniques of blasting. It shows why vibrations are usually quite harmless, and how they are measured to make sure of this. It tells how carefully blasting is done and of the many ways a user of explosives tries to be a good neighbor and useful citizen of the community. **Film Section, Atlas Powder Co., CE 7-131, Wilmington 99, Del.**

"The Story Of Creative Capital"—is a new motion picture produced by John Sutherland of Hollywood, in cooperation with E. I. du Pont de Nemours and Co., Inc. The animated color film explains what capitalism is, what capital does and where it comes from. The film, a 16 mm, in technicolor, may be used by high school, college and adult education classes, employee, religious and farm groups, labor unions, etc. Prints and full information may be had from the **Audio-Visual Services Dept. of the Chamber of Commerce of the United States, CE 7-131, 1615 H. St., N.W., Washington 6, D. C.**

"Moving A Mountain Into A Lake"—Near Salt Lake City, Utah, giant electric shovels working around the clock are tearing down a 30-million-ton mountain of earth and rock to build a new 13-mi roadbed across the Great Salt Lake for the Southern Pacific railroad. The earth and rock are transported two miles from the mountain to the lake by a Hewitt-Ribons belt conveyor system of unusual design. The story of this tremendous earth moving operation, one of the largest in the history of the world, is told in a 17-min color film. The film shows how the whole operation is carried out, and gives a detailed explanation of how the unique conveyor system was designed, manufactured and erected. **Hewitt-Robbins, Inc., CE 7-131, Stamford, Conn.**

"Concrete Products Handling"—A 17-min motion picture featuring job proven methods for handling concrete products with modern mechanical equipment has been produced for the concrete products manufacturing industry. The film covers handling of concrete block, pipe and precast products from raw material stage to storage and delivery of finished product. Sequence-type movie shots show the detailed steps in these handling techniques which were developed by leading concrete plants to reduce handling costs and breakage and increase production. **Hyster Company, CE 7-131, 2902 N. E. Clackamas St., Portland 8, Oregon.**

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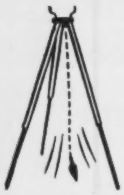
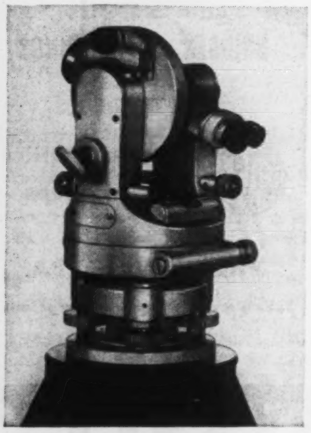


Has this been your problem? Now—old-type mechanical plumb-bob replaced by can't-miss optical principle



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Literature Available

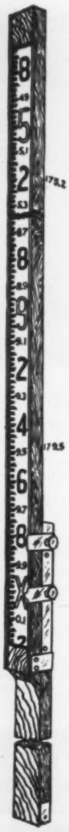
Shut-Off Valve—A new bulletin, E-39, entitled "Freyn-Jansen Burner Shut-off Valve," has been issued by the Freyn Department. Complete with scale drawings, sizes, and specifications, the new 4-page booklet emphasizes how the valve reduces stove-changing time, prevents gas leakage, provides tight, sure closure, and reduces maintenance. **Engineering & Construction Div., Koppers Company, Inc., CE 7-132, 1450 Koppers Building, Pittsburgh 19, Pa.**

Architecture—"A Story about Man and His Search for Beauty" is the title of an unusual presentation. Included in the 52 king-size page presentation are illustrations of some of the world's greatest architecture, of many dramatically beautiful present day examples of the varied use of marble, and of many illuminating scenes on the phases of marble production. The physical characteristics of their marble are given, with other technical information kept to a minimum. **Carthage Marble Corp., CE 7-132, Box N612, Carthage, Missouri.**

Blueprint Files—A new bulletin has just been released on Inter-Master Blueprint Files. Specifically designed to meet General Service Administration specifications, these files have unique advantages and a wide range of use. The bulletin points out that these Inter-Master files will interlock and intermember with standard cabinets of other manufacturers now in use throughout industry, federal, state, local and educational institutions in accordance with government standards that require all units shall interlock and intermember with their existing units. **Stacor Equipment Co., CE 7-132, 768 East New York Avenue, Brooklyn 3, New York.**

Molybdenum Disulfide—"Breaking Lubrication Barriers", is a 16-page brochure in four colors which completely covers the history and development of the Molykote line of molybdenum disulfide lubricants. A veritable textbook on the technical aspects of molybdenum disulfide as an extreme pressure lubricant, the bulletin covers the physical and chemical properties of the compound as well as providing charts which prove its superior lubricity. **The Alpha Molykote Corp., CE 7-132, 65 Harvard Ave., Stamford, Conn.**

Drills—New Parts Bulletin No. 11156, lists drilling augers, heads, bits and other accessory parts for the firm's line of McCarthy coal recovery, horizontal and vertical auger drills. Various size attachments equip the drills to bore holes from 3-in. to 48-in. The bulletin supplements Bulletins 100, 101, 102 and 105, describing McCarthy Auger Drills. These bulletins are also available upon request. **The Salem Tool Company, CE 7-132, Salem, Ohio.**



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Literature Available

Brass Fittings—The publication of a new 48-page Brass Tube Fittings catalog is announced. Listing all sizes and types of brass fittings manufactured by the company, it includes a section showing the complete line of Weatherhead drain and shut-off cocks. Other subjects covered in the catalog are push-pull controls, complete assembly instructions on all brass fittings, data on right and wrong ways for tubing a system, tube fitting data and tools. **The Weatherhead Co., Customer Service Dept., CE 7-133, 128 West Washington Blvd., Fort Wayne, Indiana.**

Vertical Pumps—A six page, five color bulletin, SCP, describing Layne Short Coupled Vertical Service Pumps has just been released. It explains the many uses of service pumps, including suggested installation plans, existing installations for oil refineries, pipe lines, municipal and private water works systems. Among the advantages listed for use of short coupled vertical pumps are: lower installation costs, reduced floor space, no priming necessary, no danger of flooding, and low maintenance and power costs, **Layne & Bowler, Inc., CE 7-133, Memphis 8, Tenn.**

Perma-Docks—Bulletin DB-215 presents Perma-Docks as a practical answer to the cost problems involved in the installation of permanent-type dock levelers, and describes how these light, easy-to-handle units self-adjust to truck or trailer floor levels automatically. Features catalogued in the bulletin include an electric-hydraulic system for fully automatic operation; special safety curbs for power truck tire protection, and crowned design for the prevention of low underclearance equipment hang-up. Also included are engineering details and specification data. **Magline Inc., CE 7-133, 1900 Mercer St., Pinconning, Mich.**

Stainless Steel—A new 32-page booklet on stainless steel sheet and strip which gives detailed information on these products is now being distributed. The booklet has more than 20 tables including detailed data on a stainless steel finder, corrosion resistance of various stainless steels, fabrication properties, and weight tables per lineal foot in various widths and gauges. There are sections on the proper selection of stainless steel grades, and an industry index of applications in the automotive, food processing, dairy, chemical, textile, pulp and paper, laundry, and other industries. **Advertising Dept., Allegheny Ludlum Steel Corp., CE 7-133, Oliver Building, Pittsburgh 22, Pa.**

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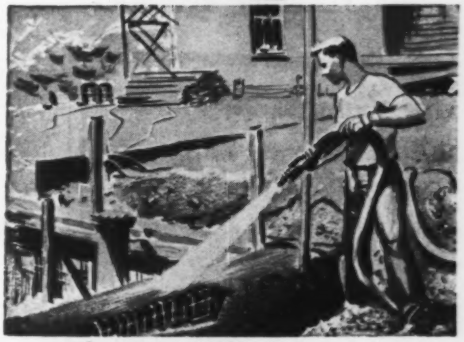

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DIRECT REDUCTION PROCESS: Republic Steel Corp. and National Lead Co. have announced the formation of R-N Corp. The new organization, owned jointly, has developed a direct reduction process, the R-N, for the treatment of both low-grade and high-grade iron ores, which will provide the steel industry with high metallic iron feed materials for use in blast furnaces, electric, open hearth and cupola furnaces . . . **25TH YEAR CELEBRATION:** Caterpillar Tractor Co. is celebrating its 25th year in the manufacture of Diesel Engines. This company was the first to build production crawler tractors equipped with diesels, and since that time has expanded to cover many fields . . . **THREE DECADES OF GROWTH:** The tremendous growth over three decades of the Stacor Equipment Co. is revealed in the opening of their new plant. Located at 273 Emmet St., Newark, N. J. and covering 65,000 sq ft, it will house all designing, engineering and production facilities for Stacor's Lifetime Steel Drafting Equipment . . . **RETIRES FROM ACTIVE DUTY:** After 42 years of service with the Lock Joint Pipe Co. of East Orange, N. J., Walter W. Trickey, vice president in charge of research, has retired from active duty. Mr. Trickey will still remain in the capacity of consultant, and also as a director of the company. At the same meeting, Hugh F. Kennison, was elected vice president in charge of engineering and research . . . **TECHNICAL CENTER COMPLETED:** A new $1¼ million technical engineering center, providing the very latest and most modern working conditions for the Trane Company's growing product engineering and design departments, has just been completed at La Crosse, Wis. The L-shaped, 65,000 sq ft building is part of a $12 million Trane expansion program . . . . **MARS CONTEST RESULTS:** 18 designs have been selected for awards in the Mars outstanding design series contest. Four designers have received cash awards; John C. Fischer, Jr., William G. Harvey, Jr., M. A. Novosel, Philip N. Seligson . . . **PROMOTION:** the advancement of S. E. Allen to vice president and general manager of all company operations and W. M. Broxham to vice president and general manager of the plate and alloy products division has been announced by Graver Tank & Mfg. Co., Inc., East Chicago, Ind . . . Henry Larsen has been appointed general works manager, tractor group, Allis-Chalmers Mfg. Co., Milwaukee, Wis. He succeeds Owen J. Higgins who was recently appointed general manager of the Harvey, Illinois works . . . **APPOINTMENT:** Morrison-Knudsen Co., Inc. has announced that M. H. Slocum is now associated with their company in the capacity of consultant on project planning and construction dam and power plant division.

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May

1255. Lateral Load Distribution Test on I-Beam Bridge, by Ardis White and William B. Purnell. (ST) This paper presents procedures, results, and conclusions from a strain gage test performed on a highway bridge to determine (1) the degree of composite action and (2) effectiveness of the diaphragms in lateral distribution of loads.

1256. Manpower Problems in the Highway Program, by C. E. Fritts. (HW) A program of action is necessary to bring more students into the civil engineering field to help the better placement of men and to place salaries on a competitive basis. Positive action must also be taken on incentives such as stability of employment and advancement, retirement benefits, working conditions, health and welfare, and professional recognition.

1257. Discussions of Proceedings Papers 884, 961, 1103, 1104, 1105. (IR) R. D. Goodrich closure to 884. N. B. Bennett, Jr. closure to 961. C. L. McGuiness, J. G. Ferris, Meyer Kramsky on 1103. Carl Rohwer, Kenneth M. Turner, Irvin M. Ingerson on 1104. M. A. Selim on 1105.

1258. Discussions of Proceedings Paper 1090. (HW) A. H. Brownfield, J. J. Naughton, Angel Piccio Villasor, Jr. on 1090.

1259. Discussions of Proceedings Papers 851, 973, 1019, 1020, 1022, 1096, 1097, 1101, 1106, 1108. (ST) Corrections to closure to 851. Corrections to 973. Roy C. Edgerton and Gordon W. Beecroft closure to 973. Milton Brumer and C. W. Hanson closure to 1019. M. W. Huggins and W. L. Lin closure to 1020. Phil M. Ferguson closure to 1022. Arturo J. Bignoli on 1096. Harold G. Lorsch on 1097. A. F. Foerster on 1101. I-Chen Chang on 1106. Corrections to 1108.

June

1260. The Efficacy of Flow Sills Under Drowned Hydraulic Jumps, by Ahmed Shukry. (HY) Velocity-measurement tests were performed on a scale model with a fixed bed representing the Edfina Barrage on the Nile River (Egypt). Effects of type and location of the floor sills on the erosive power of water were investigated under the conditions of deeply drowned jumps.

1261. Losses Due to Ice Storage in Heart River, North Dakota, by H. M. Erskine. (HY) Winter flows in the lower reaches of the Heart River (North Dakota) have been regulated by Heart Butte Dam since 1949. Flow records indicate water losses due to storage because ice is low for smaller discharges, particularly if rate of release decreases during the winter; however, the opposite is true for higher flows and increasing rates of release.

1262. Attenuation of Solitary Waves on a Smooth Bed, by Yoshiaki Iwasa. (HY) Attenuation of solitary waves by viscous shear within the laminar boundary layer on a horizontal smooth bed is considered, based on the finite amplitude theory of solitary waves. The behavior of attenuation processes is expressed in terms of the usual form, as was done by Messrs. Keulegan and Ippen, and is compared to experimental data of Messrs. Russell and Ippen.

1263. The Role of Sedimentation in Watersheds, by Fred H. Larson and G. Robert Hall. (HY) Federal participation in watershed programs depends on the premise that benefits must exceed the costs of any proposal. Because program proposals may have widely divergent effects on sediment and floodwater damages, separate appraisal systems must be devised for floodwater and sedimentation damages. The approach to sediment problems being undertaken by the United States Department of Agriculture is outlined.

1264. Stilling Basin Experiences of the Corps of Engineers, by R. H. Berryhill. (HY) This paper describes experiences of the Corps of Engineers (United States Department of the Army) in the design, operation, and maintenance of stilling basins below spillways and outlet works of reservoir projects. Several model and prototype correlations and some conclusions which may be drawn from the experience described are also included.

1265. Recirculation of Cooling Water in Rivers and Canals, by Geza L. Bata. (HY) Cooling water discharged from steam plants tends to form a warm, wedge-like stratum which extends upstream from the outlet on top of the ambient water. Both the form of the stratum and the resulting amount of recirculation are investigated analytically and experimentally, and design criteria are presented.

1266. A Study of Bucket-Type Energy Dissipator Characteristics, by M. B. McPherson and M. H. Karr. (HY) A laboratory study covering a wide range of variables, but limited to a 45° exit angle and approach slopes of 1 on 1 and 1 on 2, is described. A comparison is made with tailwater requirements for a hydraulic jump on a horizontal floor. Required bucket radii for various service conditions are specified with the objective of obtaining design criteria.

1267. Arch Dams: Stress Studies for Ross and Diablo Dams, by J. T. Richardson and O. J. Olsen. (PO) Representative results are presented of a long-time study of stress from strain meters at Ross Dam (Washington). Included is an outline of the method used to derive stress from embedded strain meters together with the preliminary results obtained from a stress study on Diablo Dam (Washington) by strain relief measurements.

1268. Engineering for Expanding Foreign Power Companies, by John F. Pett. (PO) Special problems are outlined that have been experienced by the utilities in the rapid expansion of electric power developments in Latin America. Illustrations are drawn from specific plants as well as from the background and planning for the construction of the Peixoto Plant.

1269. SED Research Report No. 12: Biological Oxidation of Alkaline Wastes, by Sanitary Engineering Research Committee, Industrial Wastes Section. (SA) Biological action does occur at pH-values of from 9 to 11. Less oxidation results at the high pH-values, but

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State ______________________ Date ______________ the capital and operating costs involved with neutralization are eliminated. Results include experiments with paper mill, textile, synthetic, domestic, and mixed wastes.

1270. SED Research Report No. 13: Milk and Food Problems in Civil Defense, by Sanitary Engineering Research Committee, Public Health Engineering Section. (SA) Milk and food resources and water supplies, which are of vital concern in emergency conditions, are subject to hazards caused by radioactivity and sabotage. Food safety and salvage problems are reviewed.

1271. Importance of Ground Water in Our National Economy, by A. C. Fiedler. (SA) Typical ground-water problems in six areas of the United States are reviewed, and it is concluded that their solution must rest on adequate knowledge of the character and capacity of the ground-water reservoirs involved and on comprehensive planning for the best use of the available ground-water supply.

1272. Surface Water Resources, by J. V. B. Wells. (SA) Over a period of years the average annual runoff for any stream tends to conform to a characteristic geographic pattern, but year-to-year runoff varies widely. Annual runoff in the United States during the period, 1953-1956, is analyzed briefly. The expansion of irrigation in the eastern states is examined, and the importance of hydrologic analyses and legislation to meet problems arising from competition with other uses is emphasized.

1273. Hydraulic Model Study of Hyperion Sewer Interchange, by Alfred C. Ingersoll and Hajime Tanaka. (SA) A 1:20 scale model of the interchange structure at the junction of two outfall sewers approaching the Hyperion Sewage Treatment Plant was tested, in accordance with the Froude Law, to determine the effects of the various flow distributions among the two influent sewers and channels leading to the new and existing headworks.

1274. Flow of Concentrated Raw Sewage Sludge in Pipes, by Sterling G. Brisbin. (SA) The problem of pumping concentrated sewage sludges is examined with data for solids concentrations of up to 16%. Friction losses with heavy solids can be computed with the Hazen-Williams formula using C-values that are from 60% to 75% of those for water.

1275. Recent Developments in the Treatment of Atomic Wastes, by Conrad F. Straub. (SA) Handling process wastes from the atomic energy industry poses some unusual waste treatment problems. Developments for handling, treatment, and disposal of radioactive liquid wastes are discussed.

1276. An Analysis of Sand Filtration, by W. A. Hall. (SA) An analytical treatment is presented of the mechanism of the filtering action of sand filters, and equations are derived for the distribution of sediment as a function of filter distance.

1277. Measurement of Sedimentation in TVA Reservoirs, by E. H. McCain. (HY) Sediment investigations in the Tennessee Valley are so numerous that special consideration should be given to the equipment used in making these investigations. Equipment assembled or developed by the TVA, which has materially increased the accuracy and efficiency of field work, is described.

1278. Automatic VHF Radio Telemetering of Hydrologic Data, by James A. Dale. (HY) The basic operation, equipment, and costs are described for a completely automatic radio gage system for obtaining rainfall amounts and stream-level data. The TVA system used for 40 stations operates on the 169-to-172 megacycle band allocated for hydrologic-data transmission.

1279. High-Pressure Steam Main Under New York City Streets, by James C. Fisher. (PL) This paper describes the design and construction of a 24-in., high-pressure steam main in New York (N.Y.). Problems of selecting a lane through congested traffic and subsurface-structure areas are described, and a description is included of special anchorage details and construction difficulties in reclaimed swamp land.

1280. Secondary Stresses in Large-Diameter Pipelines, by G. M. McClure. (PL) Predominant secondary stresses in line pipe during shipment and construction and operation of a line are examined, and examples of their magnitude are given.

1281. Pipeline River Crossings, by Leo M. Odom. (PL) The forces to be considered and the necessary investigations for the design of a river crossing of a large steel welded pipeline are outlined. The factors involved in selecting the site, determining the working season, and constructing an underwater crossing are examined.

1282. Salaries of Local Environmental Health Personnel in 1956, Report of the Committee on Salaries, Conference of Municipal Public Health Engineers. (SA) This report covers the salary status of the environmental health personnel in 1956. Changes in income status over the past five years are also given.

1283. Discussion of Proceedings Papers 1082, 1113, 1166, 1200. (HY) Harold Edwin Hurst on 1082. Louis W. Wolf on 1113. H. Alden Foster on 1166. Gordon R. Williams on 1200.

1284. Some Problems of a Penstock Builder, by John N. Pirok. (PO) Problems encountered in the building of a penstock are described—for example, those connected with engineering personnel, procurement, fabrication, transportation, erection, welding, and testing—with particular emphasis placed on problems of engineering and erection.

1285. Penstock Design and Construction, by G. R. Latham. (PO) General design features and construction procedures for various penstock installations are described and illustrated. Penstocks designed and constructed in accordance with the practice outlined result in adequate installations at reasonable cost.

1286. Arch Dams: Economy of Concrete Dams, by Louis G. Puls. (PO) Safety and economy are considered in the final selection of type for large concrete dams. This selection is further influenced by the arrangement of dam and appurtenant works. Pertinent unit cost data from sources in various countries are included.

1287. Discussion of Proceedings Papers 991 and 1042. (PO) A. Warren Simonds closure to 991. O. C. Zienkiewicz closure to 1042. Corrections to 1042.

1288. Discussion of Proceedings Paper 1115. (SA) Alex N. Diachishin, A. Pasveer, M. C. Rand on 1115.

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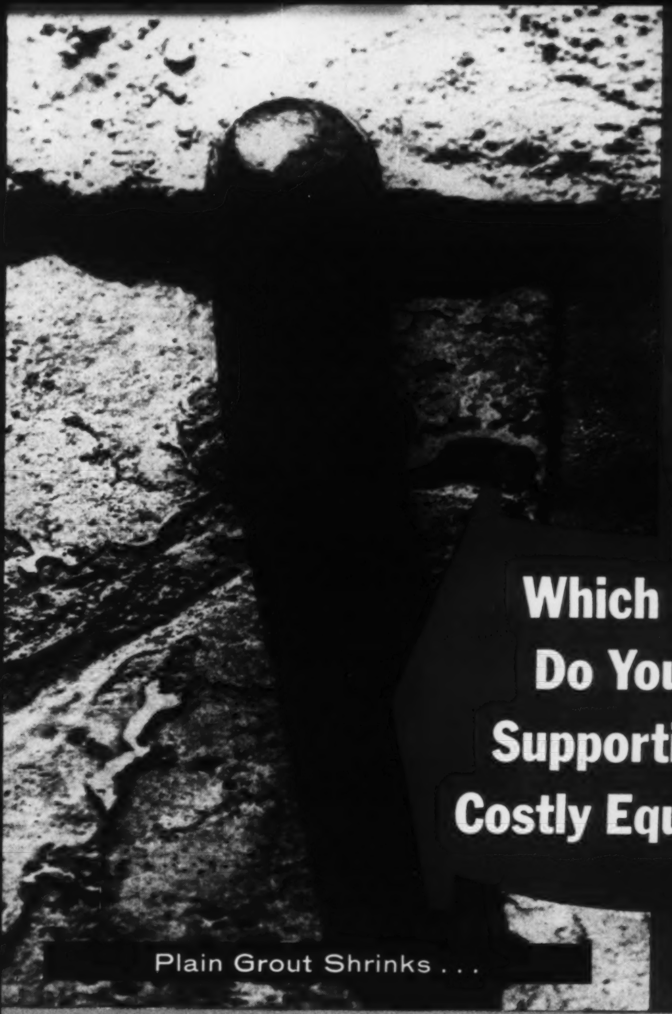
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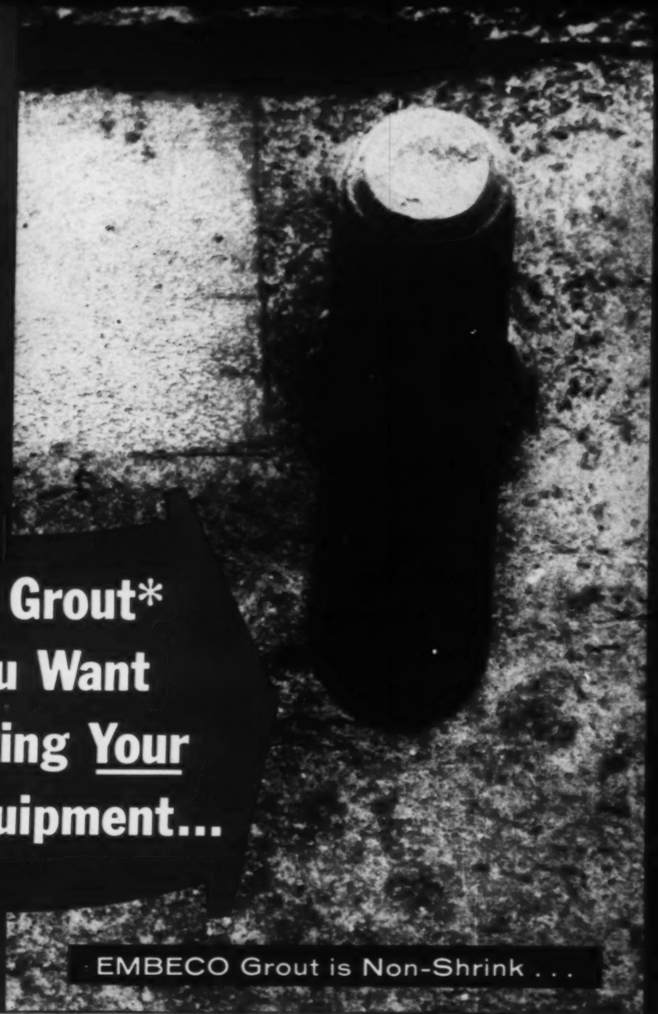
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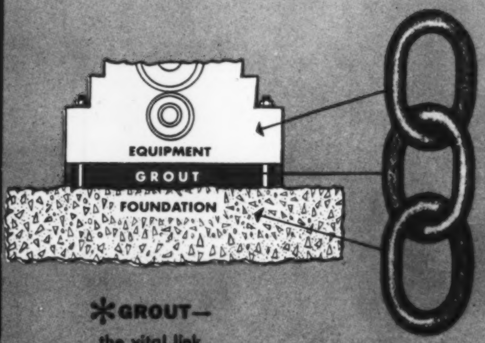

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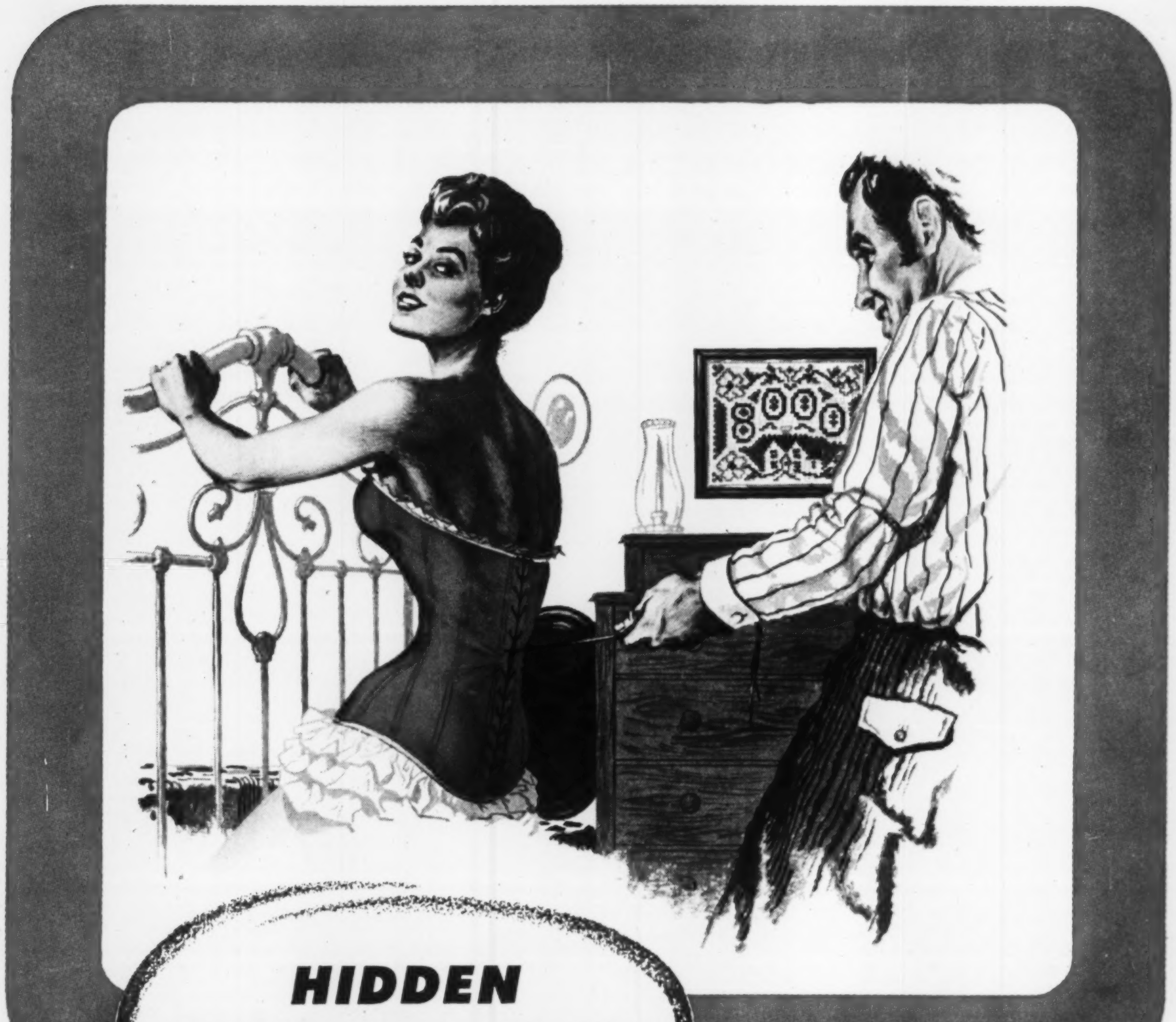

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